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The Use of Centrifugal Force

in the forming of glassware

by ROY SWAIN[1]

THERE is some doubt as to just when the blowpipe was first used by the glassworkers in the blowing of glass, but we can feel quite sure that they soon discovered the effects of centrifugal action and practiced to obtain skill in using this rather mysterious force in making new and more desirable shapes. Pipe workers have made use of centrifugal action in practically every type of work that has been adapted to pipe work. Flaring the blanks to get glass out into and build up the wall thickness at the equator of ball globes and similar shaped ware has been accomplished by rapidly turning the pipe while conditioning the blank. In this, centrifugal action has played its part well.

Another very common use of centrifugal force made by

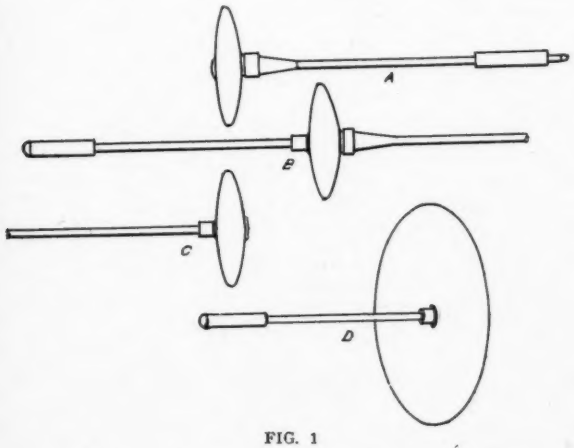

FIG. 1

the blower is swinging the pipe to elongate the blank that he is working.

Perhaps the most spectacular task ever given to centrifugal action by the glass blower was in the making of the crown window glass. In this process a ball was blown having a small heavy spot or bull's eye opposite the point at which the pipe was attached. To this heavy spot a punty was attached, and then the pipe was removed leaving an opening opposite the point at which the punty was attached. This globe was then "warmed in" and rotated rapidly. As the glass softened the hole began to enlarge very slowly at first, then suddenly opened out to a disk or circular plate. After the plate had cooled sufficiently a sharp rap on the punty detached it from the punty, to be annealed and cut to the best advantage. The "bull's eye" limited the size of the clear rectangular sheets that could be cut from this disc to very small panes. Fig. 1 shows the development of a sheet of crowned glass.

Another process developed by the glassblowers that embodied centrifugal action in a major role was that used in making concave mirrors used as reflectors for wall or bracket lamps, and also in a few headlamps. In spite of the improved lighting systems and equipment there are many thousands of these made each year. A ball of glass is blown on the end of a pipe, placed in the fire and rotated rapidly until it flattens back to two almost parallel surfaces separated by only a fraction of an inch. Then removed from the fire and while it is still pliable, the blower fashions the back with a pair of curved tools while a boy using a hardwood paddle having a convex face presses in the face of the reflector to produce the concave reflecting surface. The reflector is developed in Fig. 2.

There are few pieces of freehand glassware that do not call centrifugal action into play at some time or other during their fashioning, either by spinning in the fire or on the arm of the chair.

Blockers are sometimes able to spin their gathering of glass in the block to prevent the collapsing of the ball, but care must be taken that a hot spot is not formed in the gathering

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opposite the pipe, that will later blow thin and cause trouble. Clean iron gatherers working a wet block are able by giving their pipe a quick spin to open up or produce a small cavity at the end of the pipe to start the blow.

A great many comparatively flat articles are made from pressed blanks of a bowl or cup shape. These are caught up in a snap or stuck up on a punty and twirled in a fire to open them up, then by means of a buffer they are worked into their proper form. In this way two or more articles are made from the same mold. Occasionally two or more articles are made from the blow mold. A flanged finish is put on a blown article made in a straight-sided mold. After the waste glass is removed the article is placed in a rapidly ro-

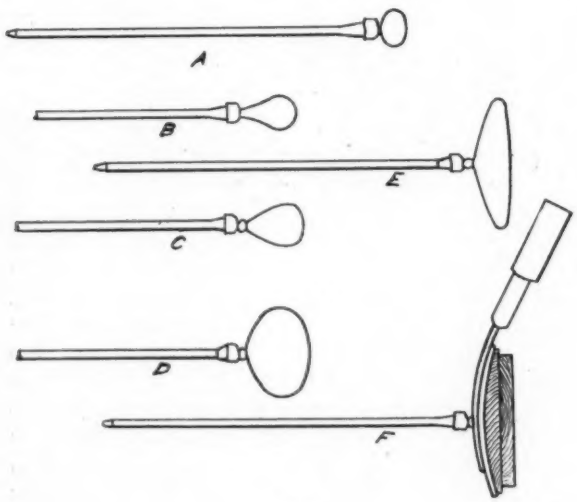

FIG. 2

tating cup surrounded by a former held stationary in relation to the cup. The former is composed of a number of small rollers, the axes of which are radial to the cup. The edge of the article is softened in a flame and by centrifugal action spun out against the rollers to take the contour of the face of these rollers. The swing-out vase is another example of the use of centrifugal action in the finishing of pressed ware.

The possibilities of using centrifugal force in glass production has appealed to a great many experimenters and inventors. Two experimenters, each working separately were able to produce bowls or nappies by spinning the mold, but apparently were unable to show commercial possibilities.

It is well known that the free surface of a liquid rotating about a vertical axis takes the form of a parabola. This has led experimenters to try this method in connection with the manufacture of parabolic mirrors, but the results were not satisfactory.

Two inventors had enough faith in their ideas to build a first class machine for the production of cylinders for oil cups and the like. The cylinders made on this machine are remarkable for the perfect distribution and interior finish, and the outer finish compares very favorably with that of pressed glass.

One thing that impressed these experimenters was the "burning out" of seeds and blisters in the glass. Perhaps this feature could be made use of in clearing up or plaining some of the special glasses used for optical purposes.

Attention might be called to quite a number of patents for methods or devices for working glass that depend largely upon centrifugal action for their appeal.

William Ambler, an English commission merchant, received a United States patent on a machine for manufacturing bottles by means of centrifugal action in 1890. This machine could only have been used in making round bottles, and coming at a time when machines were being developed for blowing bottles from both pressed and blown blanks it is doubtful if the machine received commercial consideration.

W. F. Altenbaugh conceived the idea of spinning a cup in which a finished pressed article had been placed, and by centrifugal action preventing the sides of the article collapsing. He received a patent for this in 1898.

In 1899 Irvin W. Colburn was granted a patent disclosing a machine for forming glassware similar to that made in paste molds. He proposed to take a blank of glass formed on a pipe and rotate it between rotating discs, centrifugal action forcing the glass out against the discs and the discs limiting the size and shape of the article. Colburn received several patents on glass working machines, the most important of which is the one for drawing sheet glass now used by the Libbey-Owens Company.

Daniel C. Ripley in 1902 received a patent on a method of making hollow glass articles by blowing. He proposed to use centrifugal action in forming the blank in a transfer ring.

In a patent issued to William B. Fenn in 1904 a method is disclosed for forming rollers for sheet glass manufacture. A blank pressed in a transfer or a "take out" ring was to be expanded by rotating on its axis and elongated by swinging to form a window glass roller.

Leon Appert in 1906 patented a method of forming sheet glass from a conical-shaped blank. He proposed that the cone be reheated and by a combination of centrifugal action and blowing formed into a bulb or globe. This bulb is then placed on the flattening table with the open end up and heated. The table is then spun to flatten the bulk into a sheet, much the same as in the crown glass method except that the sheet is formed in a horizontal plane while in the crown glass method the sheet is formed in the vertical plane. Perhaps patents have been granted for similar equipment for flattening shawls cut from cylinders.

Arthur E. Spinasse, whose name is well known to the flat glass industry, was granted a patent in 1915 for the cleaning of drawing pots for window glass cylinders by means of centrifugal action. Instead of the tedious draining by gravity, he proposed to spin the pot rapidly thus causing the remaining glass to flow outwardly over the edge of the pot.

In another patent recently granted it was proposed to attach molten glass to an arbor or mandrel and by rotating the mandrel cause the glass to be drawn outwardly in sheets.

Many of these patents are more fanciful than practicable but serve to indicate the desire of the inventors and experimenters to use every available means of improving glassware or the methods of producing it.

Boric Acid in Glass Manufacture

With a Review of Other Addresses by Professor Turner at Recent Meetings of the Society of Glass Technology

Interesting comments on present day practices in the North American glass manufacturing industry have been made at recent meetings of the Society of Glass Technology by Professor W. E. S. Turner of the School of Glass Technology, Sheffield, England, who last spring made an extended trip through the Eastern and Central glassmaking districts of this country. Part of his remarks as reported in various issues of the *Pottery Gazette and Glass Trade Review* of London are reproduced here.

Prof. Turner, in briefly outlining the results of work done in the Department of Glass Technology at Sheffield University, bearing upon the influence of boric oxide on the rate of melting and physical properties of colorless glass, said that one of the interesting matters which came to his notice whilst recently in America—although, of course, he knew of it before he went there—was the way in which manufacturers were bending their attention towards finding out the value and the limitations of boric oxide in connection with glass melting. The value of boric oxide in this connection was well known and recognized in the Department of Glass Technology, for they had carried out there quite a number of rather long and systematic researches; but, whilst they all realized that boric oxide in connection with glass-melting had its advantages, it also had its limitations; it had been definitely ascertained that it could not be used, with advantage, beyond a certain percentage. Once the margin had been reached, virtues gave place to vices, and that in a somewhat remarkable way.

Borax Cheaper

The value of borax as a flux had been widely known for some time, but manufacturers had, in the past, been deterred from attempting to use borax to any considerable extent, for one reason because of its price. During the past two or three years, however—for what reason he did not know; it might have been through over-production—the price of borax had been dropping, with the result that the glass industry was becoming more and more interested in its use. He believed that borax, at the present time, did not cost more than about £11 per ton, whereas at the end of the War it ran somewhere in the region of £24 per ton. In such circumstances the question had arisen as to the possibility of glass manufacturers making use of borax, and taking advantage of some of its associated virtue in connection with large-scale glass production. Trials had been proceeding in both England and America, and whilst he was in America recently he discovered unmistakable evidence that the possibilities had been envisaged by various people identified with the glass trade over there, and particularly the American Potash & Chemical Corporation, who had persuaded several firms of standing to make experiments, under guidance, in the direction of substituting some of the soda ash that had previously been employed in the batch by a definite proportion of borax. The exchange had been made in a systematic way, by taking out of the batch one part of soda ash and putting in one part of crystallized borax. At least three substantial firms had been working in conjunction with the American Potash & Chemical Corporation, and the lines on which they had proceeded had been to substitute soda ash by crystalline borax (containing approximately 47 per cent of water) in gradually increasing quantities until something like 30 lb. of borax was used to each 1,000 lb. of sand.

Advantages of Borax

The experimenting firms had noted that the substitution of borax for soda ash had led to a substantial increase in the quantity of glass which could be melted in their tanks; and, not only was the melting much more speedy, but the refining process was, it appeared, greatly assisted. The "seed" problem was now within sight of solution, and, generally speaking, the readier melting had a consequential advantage in the direction implied by the manufacturer who spoke of colorless glass as better "color." But, apart from this, one would anticipate certain improvements from boric oxide additions, providing the additions were not carried to excess. Boric oxide, as everyone knew, was usually productive of an improvement in the chemical durability of glass —the ability to withstand greater thermal shock.

In one of the American factories in which experiments had recently been made tanks which had always been operated to the limit of their capacity, and which, before the use of borax, had never been able to produce more than 60 tons of glass per day, were now shown to be capable of producing 80 tons per day. In another case a tank which had previously produced but 19 tons per day had now been converted into a 27-ton tank. And a third investigator had encountered results which could be said to be on all fours. That, of course, could justly be described as "good going."

Experiments

One of the heads of the American Potash & Chemical Corporation was himself a graduate, and his forebears had been identified with academic work. By reason of his training, such a worker was naturally rather more cautious than the average batch-mixer or the average glass manufacturer—the scientific worker usually approached his problem with greater caution than the commercial worker. In his case, therefore, he had taken steps to ensure that any tests should be carried through on a rather more definitely controlled basis than could normally be ensured in the commercial experiments of a glassworks. Consequently, he had taken steps, through the English house of the firm, Clifford, Christopherson & Co., London, to have tests carried out at the Glass Department of Sheffield University, with a view to ascertaining whether the increase in the melting rate, which had been noted under works conditions in America, was capable of being corre-

spondingly detected when trials were carried through on the laboratory scale and under definite conditions of scientific control. He was anxious to ascertain whether or not the benefits which were alleged could be definitely proved; whether the glass was, indeed, more durable; whether it could be proved that the thermal expansion was less, and therefore the thermal durability enhanced. These matters had been duly investigated, and Mr. Parkin would relate the results.

Mr. M. Parkin hereupon proceeded to describe, in detail, the tests undertaken, summing up by the statement: "There seems to be no doubt whatever that the addition of boric oxide does definitely increase the rapidity of both the melting and planing of glass; there is also an improvement in the durability of the glass; a lowering of the thermal expansion, presumably increasing the resistance of thermal shock."

THE DISCUSSION

Mr. F. W. Adams asked Mr. Parkin whether he had noticed any difference in the rate of the setting of the glass when boric oxide was used. Also, could any definite limit be stated in regard to the benefits to be derived by the substitution of borax for soda ash? Could the essayists indicate what was the best proportion to add to the batch for ordinary commercial purposes, having regard to the relative expensiveness of borax; and had the additions any effect on the amount of selenium decolorizer that was required? One had to consider the cost of borax, and therefore one did not wish to overstep the mark in adding borax to the batch.

Mr. Parkin, replying, said that he could not quote any particular limits as regards the beneficial effects of borax additions; but he and his co-workers had noted that as the additions of borax continued the changes were not so marked as in the case of the earlier additions. There was a much bigger change, for instance, between the experiments involving 0.5 and 1 per cent. of borax than between, say, 2 and 2.5. He would not say that the advantages were beginning to fall off, but they did not seem to be quite so apparent. With regard to the rate of setting, there seemed to be a slightly increased rate of working as the amounts of borax were increased.

COMMENT BY PROF. TURNER

Prof. Turner said he thought a comment at this stage might be useful. The range of tests was designed to cover what was likely to meet economic possibilities. The first series of tests at Sheffield was carried through not quite on the lines of the tests which had been done at various factories in America, but on the definite basis of putting in varying amounts of borax from 0.5 per cent. up to 2.5. In a second set of experiments works procedure was more closely emulated. It would be realized, of course, that 2.5 per cent. of borax in the glass represented an amount that was quite beyond the commercial stages yet reached in practice, and one had to bear in mind that, even with the greatly reduced price of borax, the present cost of that material did have the effect of setting bounds to the amounts which could be added in economic practice. In American factories, he thought the biggest proportion of borax introduced which he had yet come across was somewhere in the neighborhood of 1.5 per cent.; but the advantages experienced up to that stage had been so patent that the American works were now contemplating pushing on with the process, even though it meant utilizing as much as 30 lb. to 45 lb. of borax to 1,000 lb. of glass. Obviously, there must be a stage at which price offset the advantages, and there was likewise a limit to the output of tanks; it was not every factory which would be able to arrange for a whole series of molds, from small to big, to accommodate increasing output. But there was no doubt that the results which had been realized on the large scale in America, and which had been corroborated by experiments on this side by means of a wide range of experiments on a smaller scale, had shown that substantial benefit attended the use of borax in glass-making.

EFFECT ON COLOR

In reply to a question by the President as to whether the use of borax in any way affected the color of the glass, Prof. Turner said that it was the normal experience that if one obtained a good, quick melting, less selenium was required for the decolorizing, and the general statement of those who had carried out works operations was that they now needed less selenium for decolorizing than they did before the introduction of the borax. One would naturally expect that. The melting was undoubtedly easier and quicker, and that always implied the use of less selenium. The selenium got "melted in" more quickly, and once it was in solution it stayed there.

With regard to the working properties, if the glass were to suffer at all in the region between 900° and 700° C.—the temperature range over which the glass was in the mold —then production would be retarded. The contrary, however, was the experience in practice; in one case production had been increased by about 30 per cent., and in another by about 45 per cent., which obviously meant that there was no difficulty as regards the working properties.

MECHANICAL STRENGTH

Major Fred Mellor said he would like to ask the authors whether there was any improvement in the mechanical strength of the glass apart from the thermal expansion. Would the glass the better withstand pressure, or was it worse?

Prof. Turner, in reply, said that at Sheffield they were limited, of course, to small glasspots, and they were thrown back upon general principles, but undoubtedly the makers of glass articles for food-packing in America believed that their new glass was stronger than before the additions of borax were ventured upon. On general principles, based upon scientific work, that would naturally be expected; it all fell in with their theoretical knowledge. But there was another point that was very important, and they had tried to prove it, but the conditions of small-scale meltings made it difficult, if not impossible to do so. It was this: boric oxide additions, it was said, had the effect of increasing the surface hardness of glass. This was certainly an important factor in connection with the transport of glass; if scratching were prevented, this would admittedly be a great advantage. They had made some experiments on these lines, but they were hampered by the impossibility of eliminating "seed" in small-scale meltings; the presence of "seed" in glass pre-

vented them from obtaining any really correct determination of the scratch-hardness of the glass. On general grounds, however, they believed it to be true that borax does have the effect of resisting scratching.

Mr. A. E. Hill said he would like to congratulate the Department on this very useful piece of work. Prof. Turner had referred to the water of crystallization in the borax. He would like to ask whether all these experiments had been carried out with borax containing water of crystallization or whether experiments had been tried using anhydrous borax.

Mr. Parkin said that the whole of the experiments had been carried out with crystalline borax.

Practical Confirmation

Mr. F. G. Clark said that at the works with which he was identified they had been using borax in a small tank for three or four weeks now, and the results had been that the surface of the glass was very much improved. The brilliance was greater; the color was better; and altogether it seemed that the addition of borax benefited the glass. They were using borax in the proportion of 14 lb. to 218 lb. of sand, which worked out at practically 50 lb. to 1,000 lb. of batch. There was just one point he would like to mention. It was all hand-blown work that was dealt with at this particular tank, and the men at the working end of the tank required the glass to be cooler than when they were not using the borax, which rather went to show that works operations confirmed the view that the glass was more fluid. In this case, could not the temperature of the tank be reduced a little, and so minimize the wearing action upon the tank blocks? He thought that it could. Supposing they were working at a temperature of 1,400° C. at the melting end. If borax were used he believed that the temperature could be reduced by about 20° or 30° without imparing in any way the planing of the glass. He would like to add, in addition to what he had said about brilliance, that when borax was used the glass was more easily planed than it was previously.

Mr. A. J. Somer congratulated the authors of the paper, adding that he would like to say that, although this was the first time that the subject had been mentioned before the Society, borax had actually been used for a considerable period in this country, as well as in America, for the production of bottle glass. Not much had been heard of this because the manufacturers were rather keen to keep to themselves matters of this sort. He could, however, say from practical experience that he knew of an instance in England where borax was used on a large scale in the production of bottles by automatic machinery. The amount used in the first instance was 18 lb. of borax to 1,000 lb. of sand. The results quoted by the essayists in their present contribution had been fully borne out; or, should he not say, the results obtained in practice on the large scale had been amply confirmed by scientific experiments undertaken more recently on a smaller scale? The manufacturers noticed that the color of the glass was considerably improved when borax was used, apart altogether from the durability and the surface hardness. Another very noticeable effect of the inclusion of borax was an increase in the output; a speeding-up of the bottle machines enabled the output to be increased by about 15 per cent. It certainly seemed that there was considerable scope for the use of boric oxide in glass, and he hoped that the manufacturer would take advantage of the very useful information which Prof Turner and his colleagues had brought to their notice, both as regards the experiments which had been carried out at Sheffield and the works trials which had been undertaken by manufacturers in the United States. It was rather comforting to reflect that there was at least one bottle manufacturer in this country, working on a large scale, who had thought about the use of borax in connection with his batch and who had used it in practice, which went to show that matters of this sort were not left altogether to the discovery of American manufacturers, but occurred to our own manufacturers in England.

Further comment by Professor Turner is reproduced below.

Further Comment by Professor Turner on His Recent Survey of the North American Glass Industry

At one of the meetings Professor Turner exhibited samples of various materials which he had brought from the United States. Among them was a material which was now being produced in America for the manufacture of pyrometer and thermocouple tubes; it was an unbreakable material that was more or less impervious to heat treatment; and it was so durable that tubes could be inserted into molten glass and left there for months on end. For use in connection with the drawing tanks of furnaces, and particularly in connection with Fourcault window glass furnaces, where the temperature of the glass was about 1,100° C., these tubes should prove invaluable.

Glass Marbles

Samples were produced by the speaker of a series of glass marbles which were entirely machine-made, and the process of manufacture was described. A gathering of glass fell between two screw-shaped rollers, and the gob of glass was carried down between the two spirals, or rollers, and gradually assumed a spherical form before setting solid. A feature of the marble was that it was of composite color. The machine was fed automatically from two separate streams of glass—an amber and an opal each falling into a common well just at the nose of the feeder. The glass came down amber for, perhaps, three-quarters of the area around the orifice, and, on the other side, for perhaps a quarter of the area of the orifice, a stream of opal glass came down. Then, by a very ingenious mechanism, the mixed glass extruded through the orifice was not cut off straight away by shears in the ordinary way, but a revolving iron cup, swung upon an arm, came up under the orifice of the feeder, and as it rose into its operating position it was spun round and round until the gob of glass acquired a shape something like the end of a rubber screw stopper, such as was employed on the old-fashioned type of beer bottle stopper. Having acquired this shape, the

stream of opal glass was twisted round and round along with the amber, and the shears then cut off the glass, and the machine did the rest. The marbles then cooled down slowly, without the necessity of having to put them through an annealing lehr.

DOMESTIC GLASSWARE

Pointing to a group of articles which he had purchased in the Woolworth stores at Pittsburgh for a total outlay of 45 cents, Prof. Turner said that it might astonish some of our English glassmakers to know that a plain tumbler, such as appeared amongst this group of Woolworth samples, fire-finished, with a double gilt band, which involved at least two separate operations—the putting on of the band and the firing of it—sold in America for 10 cents, whilst a smaller one, similarly treated, sold for 5 cents.

Another line which was coming into domestic use in America in very large quantities was a pressed-glass dish, decorated with a deep cut, repeat patterns. This also could be purchased for 10 cents, and it was quite a nice-looking article. A rose-tinted fruit dish was produced to sell at the same figure, and a sample of this had been admired by many glassmakers who had seen it on this side, and was thought by them to be exceptionallly good value.

A salt cellar with a screw top, which could be had in either rose-pink or emerald-green—two rather favorite colors in America just now—was also found to be a 10-cent line in the chain stores. The emerald-green glass was to be seen also in tumblers and goblets, and it appeared to be selling in enormous quantities. It was interesting to note that these lines were produced in continuous tank furnaces, which, no doubt, accounted for the low price at which they could be sold.

MINIATURE LINES IN "PYREX."

A small phial in "Pyrex" glass was included amongst the samples displayed, and this, it would be interesting to hear, was produced by the discharge of "Pyrex" glass from a tank furnace through a feeder into a Lynch forming-machine. This certainly represented an advanced stage of progress, because the temperature of discharge was exceedingly high. The feeder channel itself would probably not be more than 15 in. long, and the temperature inside the channel was at least approaching 1,450° C.—a much higher temperature than was maintained in the normal glass bottle furnace at the melting end, let alone the discharge from the feeder. The average temperature in the ordinary feeder trough was somewhere about 1,200° C., but here they had to contend with a temperature near the orifice of about 1,450° C., and this could only be considered as representing the latest stage in the development of automatic glass forming.

NEW GLASS-FORMING MACHINES

Beginning at the point where he left off in his London address, Prof. Turner said that he had already mentioned that, so far as glass bottle making was concerned, the only striking development noticeable in America seemed to be that connected with the "I.S." (individual section) machine of the Hartford-Empire Co.—a machine which was already known on this side of the Atlantic, and which could be seen in operation over here—and the Knox-O'Neill machine, a description of which he had already attempted to give. The latter was a machine in which the inventor and designer had successfully applied the suction process to the gathering of the glass through a fixed instead of a revolving trough. For the particular-sized articles at present being operated the machine appeared to be thoroughly successful, and other machines were now being made for larger ware. The question would arise, as he had already suggested, as to whether two, three or more of these machines could be successfully operated side by side.

ELECTRIC BULB MACHINES

Of other machines for glassmaking purposes the most noteworthy advances had been in the direction of electric bulb manufacture,. The Westlake machine was known by most of those in his audience. This machine had been making in this country anything from 50,000 to 65,000 bulbs a day on the older-pattern machine; but the patterns had been changed, first of all by altering the design of the ram; the gathering apparatus which took up the glass from the drawing chamber had been very much simplified by reducing the number of cylinders in operation, and the efficiency and output of the machine, by reason of these changes, had increased substantially.

The record for a machine of the older type appeared to stand for the moment at 102,000 bulbs per day. At Cleveland the actual number produced usually lay between 95,000 and 100,000 per day. But the machine had undergone a reduction in size and weight, and by one of these modified machines, known as the "Ivanhoe" type—a machine that was only about a quarter of the size of the former Westlake machine, but having twenty-four arms, fixed in sets of four—a production of 85,000 to 90,000 bulbs a day had been obtained at Cleveland.

150,000 BULBS PER DAY

It was thought by the designers of the Westlake machine that it was capable of still further modification, and possibly the latest type of machine was one which had been produced in answer to a challenge from the Corning so-called No. 399 machine. The latest Westlake machine—the result of the challenge referred to—had forty-eight arms instead of twenty-four, and these were divided in sets of four in the same way as previously, and the motions were such that the arms swung upwards and outwards, instead of sideways, as in the earlier machine. The production of such a machine ran to about 110,000 bulbs per day, but the designers were hopeful that, in course of time, they would be able to get an output of 150,000 bulbs per day with this particular machine.

The general result of all this was, so far as one could see, that machines had been increased in their capacity, and in some places, where two or more tanks were being employed, it was found that the tanks were often operated four machines to a tank; they had even dwindled down to two machines to a tank, and in some instances the operators were finding it difficult to balance up the tank and get the full production they would like from the tank. But this was probably inevitable during the transition stage.

23,000 Tumblers Per Day

There was a much more wonderful machine, and one which would probably be heard a great deal more about before long in other sections of the glass industry, than the electric bulb trade. A machine was now being used by the Libbey company for the manufacture of tumblers—and nicely blown tumblers they were—at the rate of 23,000 tumblers per day. These were being produced on a 24-arm machine.

Regarding the No. 399 machine. Prof. Turner said that this particular machine was seen to be engaged on a larger-sized bulb than the standard, and it was making six bulbs per second, equal to 214,000 bulbs per day. The standard-sized bulb was said to run at the rate of 320,000 per day. It was a machine which involved an entirely new principle, and it was leaving its competitor—the Westlake machine—rather along way behind in the race for production. There were claims on both sides, of course, as regards quality, but he thought that the bulb which was being made on the new No. 399 machine seemed to be giving general satisfaction; and this seemed to constitute evidence that the machine had come to stay, and that it was going to be an important factor in determining the future course of electric bulb manufacture, in the United States at all events. It was a machine that had far too great a production for Europe, at the present stage of European development, and he mentioned it merely in order to point to it as marking an epoch in the development of mass-production, automatic forming-machines in the glass industry.

Hand Labor

Where hand labor was employed in the United States it was clearly organized so as to secure and maintain very large outputs. The lamp-working industry, identified with the manufacture of various types of light-blown chemical apparatus, was being carried on quite successfully by hand labor, but, as one of the chief manufacturers over there had said, it was only by organizing labor on a scientific plan that they could manage to hold their own with their foreign competitors. The least-skilled operators were, it was pointed out, always given a particular job to do—the job to which they were the best suited—and one job only; the work was then passed along to another operator, specially capable of performing another job. And, even when a complex piece of apparatus was given to one skilled worker, it was important to know that the maker only performed one operation at a time; he concentrated his attention for the time being on one phase of the work, and he accumulated a stock of work finished for the one process only, thus never having to change his hand or his flame.

The same thing held good in regard to the manufacture of domestic glassware. At a works in West Virginia a rather small salt bottle was seen in the making. It was a mouth-blown bottle, and the chair consisted of seven workers —two gatherers and a blower, and their three assistants, besides the taker-in. The output was said to be a thousand per move of four hours. The blower was handed gathering after gathering of glass by the two gatherers, and each of the men, performing one process only all the time, simply acted as a machine would act.

Goblets were seen being made at a well-known factory. Again the chair consisted of seven workers, who made 425 goblets per move of four hours.

A New Edge-Finishing Machine

Prof. Turner went on to describe a new type of machine being used in America for finishing off the edges of goblets. This work was not done by cracking-off, nicking with a diamond, and afterwards putting the pieces in the flame. The edge was simply melted off, outright, in an exceedingly hot flame of natural gas and oxygen. The process resulted in a nice, strong, beaded edge that was perfectly uniform, and the rest of the glass simply dropped off and went back to the cullet box. There was a single operator in charge of this melting-off machine, and he was seen to be dealing with the combined output of two whole shops, which meant that he got through, in a normal move of four hours, as many as 850 goblets. It was this organization of output which kept up production in the American glass works, and incidentally kept down the selling prices. The glassmakers worked hard, they earned good money, and they were apparently well satisfied.

Growing Recognition of Scientific Knowledge

Concluding, Prof. Turner expressed satisfaction at the way in which there was a growing increase in America in the utilization of scientific knowledge in all branches of the glass industry. Compared with four years ago, the entry of trained men into the glass industry had increased very substantially. It was a move in the right direction. Scientific control was creeping into the American glass trade in a rather astonishing way. At one factory the operations of the glass furnaces were decided, not by the sales manager or the production engineer, but entirely by the laboratory, the staff of which charted the distribution a week ahead and allocated the furnaces and the workers to specified jobs. One learned that in this particular factory there were one or two glass-blowers who earned as much as 8,000 dollars a year. This was surely a triumph for science. If science could do this for the working man of the glass industry, no one need question as to whether it was going to be worth while.

Device for Measuring Ultraviolet Rays

At the annual meeting of the New York Electrical Society in the auditorium of the Westinghouse Lighting Institute, Grand Central Palace, New York, a device developed by Dr. H. C. Rentschler, director of research of the Westinghouse Lamp Company, described a contrivance as a "dosage meter" for determining the exact intensity of ultraviolet rays in ray therapy.

It makes use of the rare element uranium which is a metal sensitive only to the ionic action of the antirichitic ultraviolet rays of the spectrum and is not affected by any extraneous light rays. It is stated that the device could so be used to determine the exact intensity of the ultraviolet rays from the sun at any given time, and thus protect an individual against too much of the powerful radiation which while not felt at the time of exposure can create sharp nervous reactions and even burns of serious intensity.

The Permeability of Glass

*to ultraviolet light**

Thesis from the Saxon Technical Hochschule in Dresden in fulfillment of the requirement for the degree of Doctor of Engineering.

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Introduction

PROBABLY no problem in the glass industry has aroused more interest in recent years than the question of the permeability of glass, especially window glass, to ultraviolet light. This question was given wide publicity through the advertising of window glass permeable to ultraviolet light, which was done especially by the Vitaglass Corporation in England.

An experiment made in two school classes in Smethwick, was epoch-making for the Vitaglass Corporation. In this school, one class room was equipped with the new UV permeable window glass, while ordinary window glass was still used in the other classes, and from the beginning of the glazing until nine months later, the haemoglobin content of the blood of the students, their size and weight, were determined.

The comparison between the students from the class equipped with Vitaglass, and the others showed the following result:

TABLE 1.

	June 1, 1925	March 31, 1926	Increase
Control class:			
Weight	60.04 lbs.	62.07 lbs.	2.83 lbs.
Height	51.78 in.	53.30 in.	1.22 in.
Haemoglobin content	76.78%	84.11%	7.53%
Vitaglass class:			
Weight	67.90 lbs.	74.01 lbs.	6.11 lbs.
Height	54.06 in.	55.92 in.	1.86 in.
Haemoglobin content	77.90%	94.04%	16.14%

Similar experiments also were made on animals in cages equipped with Vitaglass in the Zoological Gardens, and it was found that animals die much sooner in cages with ordinary window glass, and live better behind Vitaglass.

The therapeutic action of ultraviolet light has been known for a long time and also has been used in therapy. The ultraviolet spectrum itself, especially in its short-wave region, has not been investigated for a very long time.

The part of the spectrum that we call the ultraviolet, is generally from 400 $\mu\mu$ down to 180 $\mu\mu$; entering the region from 180 $\mu\mu$, the extremely short-wave ultraviolet, to about 120 $\mu\mu$ was first made possible by Schumann.[1] He found that these radiations are absorbed by air as well as by the gelatin of photographic plates, and therefore made experiments with plates low in gelatin and vacuum spectrographs and reached 120 $\mu\mu$; his experiments were carried farther by Lyman and Millican[2] and they were successful in reaching about 20 $\mu\mu$; these investigations have been of utmost importance in research on atomic structure.

Our human eyes cannot receive the ultraviolet part of the spectrum as light without the use of special aids. The greatest sensitivity of the eye is at about 560 $\mu\mu$; from here, as Fig. 1 shows,[3] the sensitivity decreases very rapidly on both sides.

The ultra-red rays, which form the continuation of the red end of the spectrum, can be noticed as sensible heat

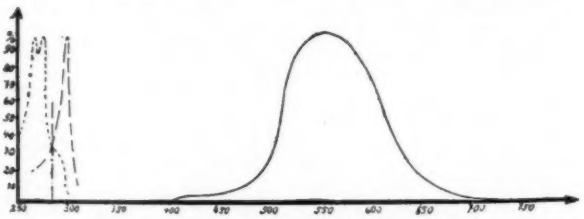


FIG. 1. —.—.—. Ultraviolet end of the solar spectrum.
——— Brightness sensitivity of the human eye.
— — — Skin tanning.
..... Absorption curve of ergosterin.

radiation, but we have no aids for making them visible to the eye. The continuation of the violet part of the spectrum, the ultraviolet, is ordinarily designated as the chemically active radiation.

This designation arises from the fact that at the present time we consider light rays as particles of energy of an energy quantum, which is inversely proportional to the wave length of the light ray. Therefore as the rays of light become shorter, they contain more energy and exert stronger effects at the places where they are absorbed.

As already mentioned above, it is not possible for us to perceive ultraviolet light, as such, with the naked eye. But in the fluorescence of certain substances we have an excellent means of convincing ourselves of the existence of ultraviolet rays. The ultraviolet light falling on such substances is absorbed by them, is converted into light of a longer wave length and they appear visibly to our eyes as the so-called fluorescent light. One of the best known fluorescing substances is uranium glass, and for this reason it is also used in ultraviolet spectrographs. It converts ultraviolet light into green light. With other substances that fluoresce less strongly, the bright light of the spectrum is screened off by a so-called light filter, and this makes it possible to distinguish fine differences in the fluorescence colors, and in this way we can differentiate between substances that shows no differences in ordinary light. Such light filters are, for example, the glasses colored with cobalt oxide; the so-called ultraviolet black glass, which is colored with nickel oxide, has achieved great importance in this field.

*Translation from *Sprechsaal*, 1929, V. 62, P. 314-15, 333-5.
[1]Weigert, Optischen Methoden der Chemie, p. 108.
[2]Weigert, Optischen Methoden der Chemie, p. 110.
[3]Glastechnische Berichte, v. 6, No. 6, p. 283.
[4]Weigert, Optischen Methoden der Chemie, p. 54.

These light filters find practical application in the analytical lamps, a mercury lamp made light-tight with black glass. By using it, one can discover minimum variations or impurities in the chemical composition of a substance; vegetable and animal oils can thus be differentiated from mineral oils, real pearls from imitations and even from those grown naturally; genuine gems from imitations, wool from cotton; different kinds of blood and secretions can easily be differentiated by the different fluorescent color tones, and forgeries on bank notes, stocks and postage stamps can be detected.

The sources of ultraviolet light are the mercury lamps mentioned above, which give a discontinuous line spectrum. They are especially well suited for quantitative photochemical measurements because, once lit, they will burn almost a week with unchanged light intensity, are very rich in ultraviolet light, and wave lengths can be recognized by characteristic groups of lines; another important source of ultraviolet light for spectrophotometric purposes is the arc between iron electrodes; the arc between tungsten and iron is also another source, and gives a perfectly continuous spectrum. Our ordinary carbon arc lamps, and last but not least, the life-giving sunlight, are rich in ultraviolet.

The temperature of the sun, calculated by different observations, is estimated to be about 6,000 degrees. Here, about 1/24 of the total radiated energy must be of a wave length smaller than 300 $\mu\mu$. But only a much smaller portion of the ultraviolet light actually reaches the earth. Most of it, as can be concluded from the broad absorption band of ozone in ultraviolet light, is consumed in the upper air strata for the formation of ozone. The shortest wave length as yet measured in the ultraviolet of the sun's rays is 289.6 $\mu\mu$[5].

The amount of sun rays fluctuates, as Hausser and Vahle[6] found, not in a year, but in the course of a day. The German investigators mentioned, found that the rays most important biologically are found only from May to September, and from 8 A.M. to 4 P. M. By the biologically effective rays, we understand the rays that act most intensively on our skin, since tanning represents the best criterium for the observation of the action of the light. The tanning curve (Fig. 1) was made by Hausser and Vahle; they allowed the individual spectral lines of a quartz mercury lamp to act on the skin until the same reddening and then the same tanning occurred. They found that with 290 $\mu\mu$ twice as much radiation energy is required as with 300 $\mu\mu$, and even 8 times as much with 310 $\mu\mu$. Although rays greater than 313 $\mu\mu$ are effective biologically, still the effectiveness of the wave lengths of 366 $\mu\mu$ is only 1/1000 approximately, as the most effective wave length of 297 $\mu\mu$. Of course, the wave length 366 $\mu\mu$ with the sun high, has the same action as the line 297 $\mu\mu$ because of the rapid drop in energy in the sun's rays. (Fig. 2.)

When the sun is low, the wave length 366 $\mu\mu$ is decisive, because rays shorter than 313 $\mu\mu$ are no longer present. This is the case in winter particularly, and this observation agrees with the fact that during this time of the year we are hardly burned by the sun. We observed further, that men are not burned as much in cities as on mountains or on the sea. The stronger action of the sunshine in these regions is explained by the fact that here, because of the less absorption, particularly of the short wave ultraviolet, more biologically effective rays are present.

The action of ultraviolet rays on the body is carried out on the direct radiation of the skin, by the circulation of

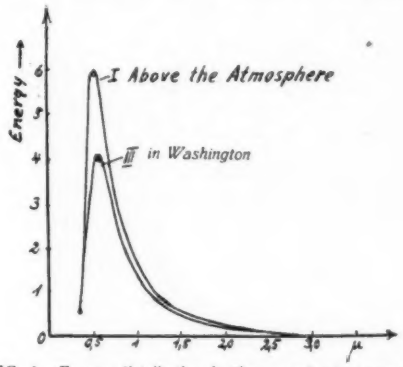


FIG. 2. Energy distribution in the normal solar spectrum.
I—above the atmosphere.
III—in Washington.

blood and lymph. Diabetes and bone tuberculosis can be healed in this manner. The bacteriocidal action of ultraviolet rays is also used in the treatment of lupus; ultraviolet radiation also has a connection with an expansion of the blood vessels of the skin, an increase in the red corpuscles, elimination of the white corpuscles from the blood vessels and migration of leucozites into ailing tissue.

The other indirect action of ultraviolet rays on the body depends on the fact that one previously radiates with ultraviolet light, the food to be given the body. It has been found in rats suffering from rickets that it was possible to cure the sick animals even by radiating their food. As Windhaus and Pohl[8] have determined, the healing agent consists of vitamin D, which is formed from ergosterin on the radiation. Ergosterin is an organic substance that shows a pronounced absorption maximum between 270 and 300 $\mu\mu$, so that it must be concluded that its chief decomposition is caused by rays of these wave lengths. Under favorable climatic conditions, vitamin D can be produced by daylight also. At the present time dry milk radiated with ultraviolet light is being used for healing children with rickets. Besides, as reported by doctors, rickets has not been observed in China, where most of the houses have no window panes, and where the ultraviolet rays in the sun are not absorbed.

But what about the plants grown in our greenhouses? The greenhouses are covered with ordinary window glass which is then covered with a more or less thick coating of lime. This coating hinders still more, the already greatly reduced permeability of ordinary window glass to ultraviolet rays, as I was convinced by an experiment with window glass with a coating of lime. Therefore, it rather seems precluded that the plants grown there can contain vitamin D that forms in sunlight. On the other hand, experiments with plants that were grown in greenhouses equipped with

[5]Jaeckel, Glastechnische Berichte, v. 6, No. 6, p. 283.
[6]Hausser and Vahle, Ztsch. f. Gesungheitspflege, 1928, p. 10.
[7]Jaeckel, Verhandl. d. Deutschen Röntgen Ges. 1927, v. 18, p. 93 et seq.
[8]Naturwissenschaften, 1927, p. 433.

glass permeable to ultraviolet, showed that these plants did not fare as well as those grown in other greenhouses. But we must remember that there are a number of plants that have been grown in greenhouses for generations and which have adapted themselves to it. In any case, it would be desirable to compare these plants with plants grown under ultraviolet garden glass, not only as regards growth, but particularly as regards their richness in vitamins.[5]

All of this shows the tremendous importance of ultraviolet light for our bodies and for our health, and it must be acknowledged that, because of the active advertising of Vitaglass, the attention of the people has been attracted to this subject. The knowledge that ultraviolet light is extensively absorbed by our ordinary window glass, so that at 320 $\mu\mu$, only 1 per cent of the ultraviolet radiation will pass through, and that we are keeping from ourselves the vital influence of the effective sun's rays, has caused other firms to take up the manufacture of window glass permeable to ultraviolet light. At the present time the following ultraviolet glasses are made:

Ultravitglas, made by Gebrüder Hirsch & Co., Kunzendorf, N.-L.
Brevosglas, made by the Deutsche Spiegelglas-Aktiengesellschaft, Grünenplan (in Braunschweig).
Ultraglas, made by Vereinigte Brander Tafelglashütten, Brand-Erbisdorf i. Sa.
Ultraviolglas, Sendlinger Optische Werke, Berlin-Zehlendorf.
Uviolglas, Schott & Gen., Jena; made in Pirna i. Sa.
Biosglas, Neue Glasindustrie Akt.-Ges., Weisswasser i. Schl.
Sanaluxglas, Tafel-, Salin- und Spiegelglas-Akt.-Ges., Mitterteich i. B.
Corexglass, Corning Glass Works, Corning, U. S. A.
Vitaglass, Vitaglass Corporation, Smethwick (England).

Main Section

1. The Historical Development of Ultraviolet Glasses

Although as already mentioned, the ultraviolet permeability of glass has been made a common question by the advertising of the Vitaglass Corporation, experiments had already been made a long time previous, on the manufacture of glass permeable to ultraviolet; although at that time there was less intention to make window glass permeable to ultraviolet. Rather, this glass was intended to be used primarily for optical purposes, for telescopes, etc., and the composition of the glasses made, corresponded to these uses.

First, Eder and Valenta[9] showed that phosphate crown glass is very transparent to ultraviolet.

Extensive experiments on the influence of the individual oxides present in the glass, on the ultraviolet transparency, were made by Zschimmer[12] in 1903. The result of his experiments is shown in table 2.[10]

In this table the high ultraviolet permeability of boric acid is noteworthy. In a layer 3 mm. thick, it still permits radiation to 186 $\mu\mu$ to pass through. We also see from the table that the bases displace the permeability limit toward the higher wave lengths; lead oxide most strongly of all,—hence the use of leadidymium glasses as protecting glasses for x-rays. The displacement by zinc oxide and barium oxide is less strong; it is stronger with soda than with potash. The rather high permeability of the fluorides to ultraviolet is also noteworthy.

The Jenaer Glaswerken succeeded, in connection with these experiments, in making crown and flint glasses of high ultraviolet permeability, which found use extensively for astronomical photography.

Other experiments on the ultraviolet permeability of glass were made by Fritsch and Lindemann.[11] They fused glasses

TABLE 2[10]

Glass No.	Chemical Composition Calculated by Synthesis									Wave Length	Thickness
	B_2O_3	Na_2O	K_2O	BaO	ZnO	M_2O_3	PbO	CaF_2	BaF_2	$\mu\mu$	mm.
V.S.145	100	..	..	..	..	..	..	..	..	186	3
1456...	85	15	..	..	..	..	..	..	..	186	3
2161...	74	26	..	..	..	..	..	..	..	226	3
2164...	70	30	..	..	..	..	..	..	..	275	2
1676...	79	..	21	..	..	..	..	..	..	199	3.5
1453...	41	..	..	..	59	..	..	..	..	245	3
1677...	57	..	..	43	..	..	..	..	..	210	3
2159...	50	..	..	50	..	..	..	..	..	231	4
1674...	64	12	12	12	..	..	..	..	..	245	2
1675...	40	..	..	55	..	5	..	..	..	280	3
2938...	25	..	..	65	..	10	..	..	..	280	5
1671...	66	..	..	..	..	4	..	30	..	226	3
1700...	56	..	..	..	..	4	..	40	..	257	3
2524...	40	..	..	..	..	..	..	..	60	257	2.5
2022...	40	..	..	50	..	..	10	..	..	346	3.5

	B_2O_3	SiO_2	Na_2O	K_2O	ZnO	BaO		
2139	22	58	5	15	..	..	275	4
2944	25	15	..	..	15	45	275	5
2191	..	78	..	22	..	..	245	3
2182	..	68	..	32	..	..	257	3

from boric acid, calcium fluoride and alumina, which likewise absorb very slightly in the ultraviolet, and they are used especially in spectrographs.

In addition to these glasses that are very useful for optical purposes, but which are too expensive for window glass, and which also were proved unsuitable by Mylius and Foerster as regards their hydrolytic class, ultraviolet-permeable glasses have appeared earlier. It was announced by Zschimmer as early as 1903[12] that the Jenaer Glaswerke would take up the manufacture of ultraviolet-permeable window glass. As was stated by Jäckel[13] in a comprehensive paper on ultraviolet-permeable window glass, after a discussion by Berger-Jena, a shipment of this new window glass was made in 1914 to a hospital in Angona, but this shipment was lost in the excitement of the mobilization period.

2. The Characteristic of Modern Ultraviolet Window Glass

Our modern ultraviolet window glass can be differentiated from that previously made and used in optics by the following: We do not try to increase the ultraviolet permeability of the glasses at the cost of their hydrolytic quality since one is unconcerned about the chemical susceptibility of the ultraviolet permeable oxides used, but one rather increases the ultraviolet permeability of ordinary lime soda or lime potash glasses by trying to keep them as free as possible from an oxide that is unintentionally brought into the glass with the other raw materials. This oxide is iron oxide. The modern ultraviolet glasses are made of material as free from

[9]Eder and Valenta, Denkschrift der Wiener Akademie der Wissenschaften, v. 61.
[10]H. Schulz, Das Glas, p. 136.
[11]Ztsch. f. Physik 1907, p. 513.
[12]Ztsch. f. Instrumentenkunde 1903, p. 360.
[13]Jaeckel, Glastechnische Berichte, v. 6, No. 6, p. 288.

iron as possible, and in addition, one tries to convert any iron that may be present, into the ferrous form by a hot and reducing melt, and, as I concluded from the investigation of the commercial glasses, by extremely strong reducing agents such as tin chloride. As a special flux, some glasses contain boric acid, which is especially permeable to ultraviolet, also zinc oxide, alumina and barium oxide. Since these latter fluxes and the exact oxide composition are subordinate in the ultraviolet permeability, I will not give the exact composition of the commercial glasses here with regard to the firms making them. An exception to the modern glasses as regards composition, is made by the American Corex† glass (Jäckel),[13] which is more strongly permeable to ultraviolet than the other commercial glasses, but is useless hydrolytically as window glass. It consists only of boric acid, lime and phosphoric acid, and thus in its composition reminds one of an ultraviolet glass mentioned previously. Titanium dioxide is also known to absorb ultraviolet strongly; but the ultraviolet absorption by titanium dioxide plays a very minor part in the glass as it always appears in very small amounts in connection with iron in some raw materials.

As was already stated, the main thing in the new ultraviolet glasses is that they should be as free from iron as possible and the iron should be reduced to ferrous oxide as far as possible; for it is a fact that hitherto has not been expressed, but has been known in manufacturing circles, that trivalent iron in the glass shows much stronger ultraviolet absorption than divalent iron. The main part of my further work was the investigation of this and its detailed study both chemically and physically.

3. Measurement of the Ultraviolet Light Permeability with the Spectrograph

From what has been stated in the introduction, it must appear that we must not only determine to what wave lengths the different glasses under investigation are permeable to ultraviolet light, but especially to determine what per cent of the incident light passes through with the different wave lengths. For this purpose I used a Zeiss spectrograph which permitted measurements in the visible as well as in the ultraviolet part of the spectrum. The principle of this apparatus is as follows:

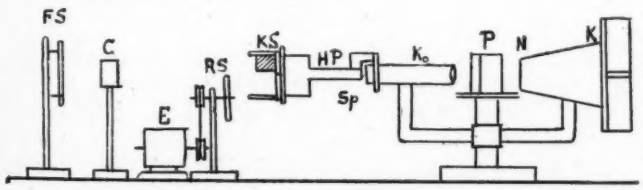


FIG. 3

FS—quartz mercury light, C—condenser, HP—Hüfner prism, Ko—collimater, P—Cornu prism, Sp—slit, KS—quartz bulbs, E—electric motor, RS—rotating sector, K—camera, N—camera objective.

The rays from the light source—we use a mercury quartz lamp for this—pass through the condenser C and fall on the quartz bulbs KS. For studying solutions, bulbs are used which are closed in front and back by quartz sheets, while in the study of glasses, the glass can be clamped in the bulb holder. Naturally it is assumed that we have a flat smooth polished surface; if the glass to be studied does not have this, we must cut a piece out and fit it in a bulb which is then filled with water to avoid loss by reflection. The bulb is closed with quartz plates, because these are practically perfectly permeable to ultraviolet light to 230 $\mu\mu$.

Behind the bulb holders there is a Huefner prism by which the rays of light from the source are analyzed into groups separated by narrow bands. These then pass through the slit Sp and through the collimater lens, a quartz-fluoride achromat; from here, they pass through a Cornu quartz prism P to the camera objective N. At the end of the camera there is a ground glass with a fitted streak of uranium glass in order to be able to see whether the light intensity is the same on both bulbs.

The adjustment to equal brightness is made by displacing and raising and lowering the condenser as well as the entire spectrograph. For the exact testing of equal light intensity we must make exposures in which nothing, or equally thick quartz plates, are placed in the two bulb holders. Only the equality of line intensities of the exposures under the microscope gives the assurance of equal light intensity.

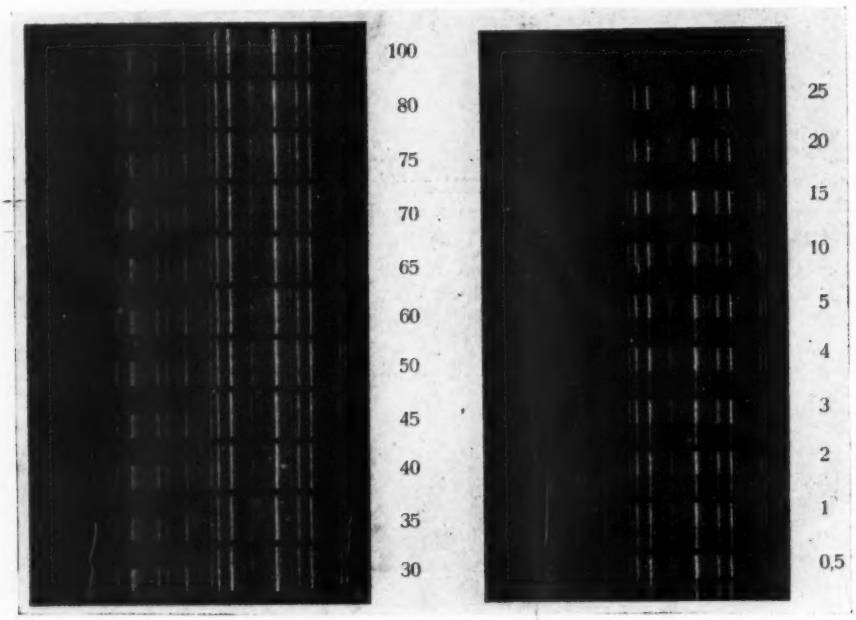
The spectrum of the quartz mercury lamp is a line spectrum. Each line in this spectrum corresponds to a certain wave length. If this line spectrum is observed behind a medium that absorbs a part of the incident light, and at the same time behind a medium that permits light to pass through unhindered, we get a measure of the absorption by the different intensities of the lines. However, as one can recognize lines of equal intensity much better, we use the following device. By the use of a rotating sector one weakens the part of the light that passes through the non-retarding medium, and in this way one obtains a weakened spectrum that can be measured. Thus, it is possible to measure the weakening of the ultraviolet absorbing medium by line equality. Illustration 4 shows this best.

The picture shows the absorption spectrum of Sanalux glass, which was radiated with ultraviolet light for two hours. On the plate there are 21 partial exposures in all. Each exposure shows, only separated by a narrow strip, the spectrum of the glass to be studied and the spectrum of a quartz plate. The numbers at the side show what per cent of the quartz spectrum has been weakened by the rotating sector. We see, for example, line equality of wave length 297 $\mu\mu$ at 50 per cent weakening, while at 294 $\mu\mu$, line equality only occurs when 40 per cent of the light is present.

I wish to remark that if the sector is displaced only 1 deg. each time, dividing the entire sector circle into 400 deg., an accuracy of 0.5 per cent can be attained.

The evaluation of the exposures, that is, the comparison of the thickness of the individual wave length lines, is done as follows: The plates were laid on a sheet of milk glass and this in turn was illuminated by a table lamp. The table lamp was provided with a sheet screen whose open side is covered by the milk glass plate. The comparison of the line strengths was done with a good lamp.

† Upon submitting a copy of this statement to the Corning Glass Works with a request for their comment, we were informed that some of the earlier glasses produced by that Works under the trade name "Corex" showed some weathering. Their later ultraviolet transmitting glasses, however, are thoroughly stable both as to weathering and solarization.—Ed.



4. Conversion of the Per Cent Permeability of Glasses of Different Thickness to the Same Thickness

In order to get an exact unit for the permeability of the different glasses, we always must refer the permeability to the same glass thickness. For this we use Beer's law:

$$\epsilon = \frac{1}{c.d} \log . \frac{J_0}{J}$$

which, although derived for aqueous solutions, also holds for glass to a limited extent. Here:

ϵ—molecular extinction coefficient
c—concentration
d—thickness of the layer
J_0—intensity of the incident light
J—intensity of the light passing through,

$$\frac{J_0}{J} = E = \text{extinction.}$$

With glass, c is always 1.

Measured in this manner and referred to a thickness of 2 mm, the percent permeabilities of the ultraviolet glasses on the market, and some test melts give the following tables.

TABLE 3A

(Ultraviolet permeability of commercial glasses in per cent.)

μμ	Brevos	Ultravit	Uviol	Sanalux	Vita
260	0,5	0,6	0,5	0,8	1,0
265	2,0	2,0	2,0	2,5	2,5
270	4,5	4,5	4,5	5,0	6,0
275	9,5	9,5	10,0	10,0	12,5
279	20,0	17,5	17,5	20,0	23,5
285	34,8	31,0	35,0	35,1	34,9
289	45,0	42,5	45,0	42,5	42,5
294	56,5	54,0	59,0	50,0	50,0
297	60,0	57,5	65,0	56,0	55,0
302	67,5	65,0	73,0	72,5	61,0
312	78,0	75,0	82,5	74,0	72,5
334	89,0	88,5	90,0	88,0	88,0
340	92,0	91,0	91,0	91,0	91,0

TABLE 3B (see next page)

The figures after the wave lengths in μμ indicate the ultraviolet permeability in % of the incident light; under it, are placed the oxide compositions of the glasses and the data on the raw materials used for its manufacture.

EXPLANATIONS FOR TABLE 3B

Raw materials used:

Sand	W = Wittenberg sand with	0.022% Fe_2O_3
	D = Dörentruper sand with	0.006% "
Feldspar	F = feldspar with	0.086% "
Calcite	KSp = calcite with	0.033% "

Calcareous marl = KM = calcareous marl with 0.004% Fe_2O_3.

5 Determination of FeO in the Presence of Fe_2O_3 in Glass.

The determination of di and trivalent iron in ultraviolet glasses is very difficult because there are much smaller amounts of iron than in ordinary glass. The investigations that were made previously on the determination of iron in glass were always made with a larger or smaller iron content. In glass sands with small amounts, only the total iron was determined. The determination of the two oxidation stages of iron in glass only became important due to the discovery of Zsigmondy[14] that ferrous oxide in glass reduces the permeability of heat rays considerably, as a matter of fact, to such an extent that these glasses can be used as heating insulating glasses. For 1 per cent FeO in a glass 5 mm. thick reduced the permeability of heat rays from 60 per cent to 0.76 per cent. H. Heinrichs and Edith Heumann[15] first studied the iron ratios in glasses. They found that in a green glass, which is not a heat-insulating glass, the ratio $\%FeO/\%Fe_2O_3$ is about 0.3, while in blue protective glasses, it is about 2.0. As regards the color of the iron glasses, they referred to the works of G. R. MacCarthy, according to which, the following iron silicates exist in nature: colorless ferrous oxide silicate, blue hydratized ferro-

(*Continued right-hand column, next page*)

[14]Dralle-Keppeler, Die Glasfabrikation.
[15]H. Heinrichs and E. Heumann, Glastechnische Berichte, v. 5, No. 4 p. 158.

TABLE 3B

μμ	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9
289	—	—	—	—	—	9,1	8,0	—	—
294	—	—	—	—	—	15,0	11,5	3,6	0,6
297	1,5	—	4,1	10,2	—	24,8	22,4	7,8	6,1
302	10,0	2,5	14,3	27,6	—	35,0	31,4	19,9	10,0
312	20,0	27,6	55,7	57,4	38,0	75,0	73,0	39,3	23,3
334	70,0	80,0	81,0	81,3	60,5	86,0	84,0	61,6	77,0
340	75,0	82,0	82,0	82,5	65,0	86,5	86,0	70,0	78,0
SiO_2	73,9	73,5	73,1	72,6	72,1	73,3	72,7	72,2	73,4
B_2O_3	3,0	3,1	3,1	3,1	3,1	3,1	3,1	3,0	3,1
Al_2O_3	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0
CaO	6,8	6,7	6,7	6,6	6,6	6,7	6,7	6,6	6,7
K_2O	4,7	4,7	4,7	4,6	4,6	4,7	4,6	4,6	4,7
Na_2O	8,6	8,2	8,0	8,0	8,0	8,5	8,4	8,3	9,0
SnO_2	—	0,7	1,4	2,1	2,8	0,7	1,4	2,2	—
NaCl	—	—	—	—	—	—	—	—	1,0
W,D	W	W	W	W	W	D	D	D	W
F	F	F	F	F	F	F	F	F	F
KSp	KSp	KSp	KSp	KSp	KSp	—	—	—	—
KM	—	—	—	—	—	KM	KM	KM	KM

μμ	S_{10}	S_{11}	S_{13}	S_{14}	S_{16}	S_{17}	S_{18}	S_{22}
289	—	—	—	—	0,5	—	—	—
294	—	—	—	—	0,6	0,6	—	—
297	3,5	3,3	—	3,5	2,1	1,3	1,3	2,0
302	7,6	7,2	2,8	12,0	8,8	5,8	5,5	6,2
312	26,1	25,3	10,7	35,9	30,9	39,4	41,0	22,4
334	78,3	77,9	77,4	78,3	76,7	77,1	78,3	52,5
340	79,0	79,0	78,0	79,3	77,0	78,5	79,0	66,6
SiO_2	73,1	72,7	73,8	73,8	73,5	73,3	73,0	73,9
B_2O_3	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,0
Al_2O_3	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0
CaO	6,7	6,7	6,8	6,8	6,7	6,7	6,7	6,7
K_2O	4,7	4,6	4,7	4,7	4,7	4,7	4,7	4,7
Na_2O	9,5	9,9	8,5	8,5	8,5	8,5	8,5	8,6
C	—	—	0,15	0,2	—	—	—	—
As_2O_3	—	—	—	—	0,5	1,0	1,5	—
NaCl	2,0	3,0	—	—	—	—	—	—
W,D	W	W	D	D	D	D	D	D
F	F	F	F	F	F	F	F	F
KM	KM	KM	KM	KM	KM	KM	KM	KM

μμ	S_{23}	S_{24}	S_{25}	S_{102}	S_{103}	S_{107}	S_{108}
265	—	—	—	—	—	7,5	—
270	—	—	—	—	—	12,4	0,3
275	—	—	—	—	2,0	15,6	1,1
280	—	—	—	6,7	3,6	32,7	2,2
285	—	—	—	9,2	16,2	41,3	5,6
289	2,7	6,5	9,0	22,4	38,6	47,8	8,3
294	4,2	9,2	11,5	—	—	52,2	12,9
297	5,8	17,2	20,0	40,8	48,5	57,2	17,6
302	16,8	27,5	28,5	55,0	57,8	73,5	47,3
312	25,1	39,4	59,2	74,2	—	81,5	71,3
334	75,0	80,0	82,5	—	—	90,0	87,5
340	80,0	82,5	84,0	—	—	—	90,0
SiO_2	74,1	73,9	73,6	69,4	69,4	48,3	49,7
B_2O_3	3,0	3,0	3,0	2,2	2,2	23,1	23,7
Al_2O_3	3,0	3,0	3,0	—	—	—	—
BaO	—	—	—	4,4	1,2	—	—
CaO	6,7	6,7	6,7	1,5	1,5	—	—
K_2O	4,7	4,7	4,7	12,4	12,4	17,0	17,5
Na_2O	8,3	8,3	8,3	5,1	5,1	10,3	10,6
ZnO	—	—	—	3,3	3,3	—	—
SnO_2	—	0,37	0,73	0,5	0,5	1,3	—
MgO_2	—	—	—	1.6	—	—	—
W,D	D	D	D	D	D	D	D
KM	KM	KM	KM	KSp	KSp	—	—

(*Continued from page 220*)

ferri compounds, gray or black anhydrous ferro-ferri compound and yellow or red ferri-compound. According to Heinrichs, if the same ratios could be assumed in glass as in the minerals, ferro-ferri silicates could exist in the blue colored glasses in which silicic acid has entered in the position of the hydration water. The greenish streak can be explained easily by partial oxidation of the blue compound to yellow iron silicate and the formation of the green mixed color between blue and yellow. I mention these opinions of Heinrichs particularly, because, as I shall show later, there are actually very many agreements between aqueous iron solutions and glasses containing iron, which seem to confirm Heinrich's assumptions.

(*To be continued*)

Foreign Activities in Glass

THE GLASS SITUATION IN CHINA

Although China has reached a certain development in the manufacture of the more or less ordinary glassware, such as window glass, etc., the technical progress and modern manufacturing methods seem entirely lacking. It is therefore impossible for the domestic industry to satisfy the demand of their customers. True, there are at least two factories, one at Tschingwagtau and the other at Dairen, of which the former is by far the larger and more potential in output as well as capacity, the output amounting to about 150,000 cases annually. It is for the reason of the limited production capacity of the Chinese plants, that the imports still are reaching a very considerable amount. It is estimated that the annual figure comes to between 5 and 6 million taels which, converted at the rate of 58c per tael, represents between 3 and 3.5 million dollars. The first position in the import business is held by Japan, then follows Germany, Belgium and England, while the United States and Czechoslovakia play an important part in a number of articles. Window glass is the largest import article, the annual amount being 2 million taels or $1,160,000 of which Belgium takes about 50 per cent, while Germany and England practically share in the balance. Here, however, the slowly increasing domestic production influences the imports from abroad by reducing little by little the foreign share, and as soon as modern methods and manufacturing systems are put into effect, there can be but little doubt as to considerable reduction of the imports from abroad. Mirror glass imports, on the other hand, are increasing, Belgium again predominating with Germany and England closely following.

The principal markets for the sale of glass and glass products are Shanghai, Canton and Tientsin from which the distribution all over this tremendous country takes effect.

INCREASE OF GERMAN IMPORTS

In spite of the ever increasing efforts to increase glass production, the German manufacturers have not been able to reduce the imports. To the contrary, they are decidedly on the upward grade. The first four months of the last five years, for instance, show this increase beyond any doubt: In the months from January to April, 1925, glass was imported into Germany to the value of $1,310,000; during 1926, $762,000; during 1927, $1,666,000; 1928, $2,262,000; and 1929, about $2,600,000. These figures include all kinds of glass and show clearly the upward trend of the German imports.

SILESIAN SCHOOL FOR GLASS ARTS AND CRAFTS

As is well known, the state of Silesia represents an important part of the German glass industry. It was therefore since long the intention of the interested producers to open a special school where all the finer things about art, craft and workmanship could be taught. This project fell through as the city of Breslau was not ready to take over part of the cost. Now the state has approved a project to erect such a school in Bunzlau, the state giving the larger part of the cost of construction, while the city contributes the other part of the construction cost and land as well as an annual allowance for the maintenance of the school. The new project has thus apparently become a fact.

The Manufacture of Wire Glass

as exemplified by patented inventions

by JOSEPH ROSSMAN
Patent Examiner, U. S. Patent Office

(Continued from the August issue)

24. Franzen, 741,125, October 13, 1903.

This method consists in rolling a sheet upon a table, rolling another sheet above and in spaced relation to the sheet formed upon the table, simultaneously applying to the under face of the upper sheet, wire-netting and finally uniting by rolling the two sheets with the wire interposed between them.

25. Paxton, 753,101, February 23, 1904.

The method of making sheet-glass with a metallic center portion consists in depositing a single batch of glass upon a suitable support, then dividing it into a front and a rear portion, introducing the metallic center at the divided point, and simultaneously spreading the front portion of the glass under the metallic center and the rear portion above the metallic center.

26. Diaz, 764,991, July 12, 1904.

The combination in sheets of metallified glass, with the usual metal webbing surrounded by glass, of a metal frame partially embedded in the glass and projecting beyond the sheet, the webbing being connected with the frame.

27. Wadsworth, 773,174, October 25, 1904.

A plate glass having prisms at one face and provided with metallic strips immovably but partially embedded within the body of the plate, a portion of each strip being exposed beyond the glass.

28. Wadsworth, 773,305, October 25, 1904.

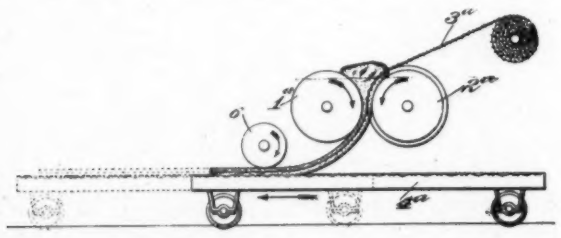
The method of making glass sheets consists in protecting portions on both sides of a wire mesh from contact with the glass and then forming the glass in sheet form around the intermediate and unprotected portions of the mesh.

29. Wadsworth, 773,307, October 25, 1904.

The method consists in first, spreading the glass into a sheet, then pressing its surface to form projections thereon, and then reshaping the surface of the projections, and simultaneously interlocking a mesh therewith.

30. Walsh, 776,158, November 29, 1904.

The method of making wired glass consists in forcing a



776,158

wire mesh into molten glass and permitting the glass to flow through the mesh so as to center the glass therein by forming it in a sheet, exposing the under side of the sheet for a brief period to atmosphere for the purpose of slightly cooling it and then pressing the under surface of the sheet against a bed or table.

31. F. Shuman, 786,058, March 28, 1905.

The method described in this patent consists in depositing a single batch of glass upon a suitable support, then dividing it into a front and a rear portion, introducing the metallic center at the divided point, and simultaneously spreading the front portion of the glass under the metallic center and the rear portion above the metallic center.

32. A. Shuman, 788,147, April 25, 1905.

The process of making wire prism-glass consists in first rolling the molten glass into a sheet with meshed wire embedded in it and then forcing the meshed wire down into the upper part of the sheet of glass and simultaneously molding the glass above the meshed wire into prismatic ribs.

33. Schmertz, 791,216, May 30, 1905.

This patent for the process of manufacturing wire-glass consists in rolling a sheet of glass of about half the ultimate thickness required, simultaneously with the formation of the sheet forcing wire in the sheet and forming a second sheet upon the first sheet.

34. Schmertz, 791,217, May 30, 1905.

An improvement in the process of manufacturing wire-glass which consists in rolling a sheet of glass of less thickness than the ultimate product required; simultaneously feeding by gravity wire upon the top of the sheet at the rear of the leading roll and rolling a second sheet of glass upon the original sheet and the wire, simultaneously embedding the wire and finishing the sheet.

35. F. Shuman and A. Shuman, 792,172, June 13, 1905.

The process of making a sheet of wire-glass consists in first producing a sheet of wire-glass of the maximum size, then placing lines of cuts in the surface of the sheet at a short distance from and substantially parallel to the edge, and then crushing and removing the glass between the lines of cuts and outer edges to expose the meshed metallic center.

36. Wadsworth, 797,646, August 22, 1905.

The method consists in forming a sheet between rolling-surfaces on both sides of an intermediate mesh while the mesh is supported by its margin only, and then subjecting the surface of the sheet to the action of figured pressing surfaces.

37. Baldwin, 804,821, November 21, 1905.

Wire-glass is made by forming the sheet in a single roll-pass and introducing the wire by gravity and simultaneously with the formation of the sheet to the center of the roll-pass and subjecting the sheet upon its delivery from the roll-pass to the action of an air-regulating blast.

38. White, 805,609, November 28, 1905.

The method of making glass plates consists of forming two or more sheets of glass, depositing them in succession one upon a supporting surface and the other upon the first

sheet and interposing a metallic web or fabric between the sheets.

39. White, 805,610, November 28, 1905.

The method of making glass plates consists in forming a glass sheet along a suitable bed or support, placing a metallic web or fabric thereon and reversing the direction of distribution of the sheet without interrupting its formation; thereby inclosing the metal web or fabric between portions of a continuous sheet.

40. Franzen, 823,112, June 12, 1906.

The method consists in first teeming a batch of molten glass upon a forming surface, second, simultaneously spreading the batch of molten glass to layer form, applying to the surface thereof a fabric, and causing separated or segregated portions of the batch of molten glass to rise through the fabric in protuberances of molten or unchilled glass; and, finally spreading the protuberances into a layer upon the farbic-faced layer.

41. Walsh, 831,640, September 25, 1906.

A sheet of glass having embedded therein a plurality of layers of wire fabric arranged parallel to the outer faces of the sheet and with their meshes overlapping each other, the layers of fabric being spaced away from each other and also from the outer faces of the glass sheet whereby a continuous layer of glass of uniform thickness is interposed between the layers of wire fabric.

42. White, 835,148, November 6, 1906.

The method of forming glass plates consists in placing a mass of glass upon a bed or table, spreading a portion of the glass in one direction into sheet form, embedding a fabric or web in the surface of the portion of the glass in the opposite direction over and upon the portion first spread.

43. Franzen, 835,511, November 13, 1906.

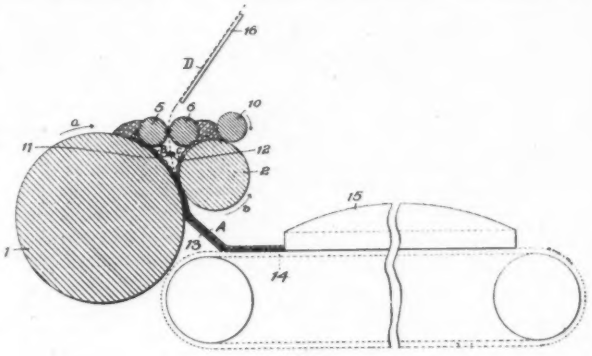
The method of making wire-glass consists in teeming a mass of molten glass upon a movable table, forming above the table and out of contact therewith a wire-including component layer of the finished sheet, and spreading the mass of glass upon the table by means operative through the wire-including layer.

44. Franzen, 839,573, December 25, 1906.

The present invention consists in providing between the molten glass and the former which spreads the molten glass to layer form a layer or stratum of substance which will insulate to a greater or less degree against the conduction of heat from the glass to the former and in so insulating will protect the glass from chilling contact with the surface of the former. The effect will be that the layer spread by a former thus insulated will have a surface less chilled or hardened and accordingly in better condition to weld or unite with its fellow. This insulating blanket or stratum which envelops the former is preferably steam.

45. Franzen, 839,574, December 25, 1906.

The method of making wire-glass consists in spreading a batch of molten glass to a layer bearing upon its surface protrusions of soft or unchilled glass, spreading a second batch of glass to layer form, and uniting the layer upon the protrusion-bearing surface of the first-named layer and through the meshes of a fabric.



839,574

46. Wadsworth, 844,484, February 19, 1907.

The method of making wire-glass consists in placing the mesh under tension to support it above and in spaced relation above a forming-surface, pouring molten glass on the wire mesh, causing glass to pass through interstices of mesh and embed it in the body of the glass, and maintaining the mesh under tension in substantially the same spaced relation while being embedded in the glass.

47. Wadsworth, 844,485, February 19, 1907.

This process consists in superimposing the wire mesh over a body of glass, flattening such wire-glass and forcing the wire mesh into the glass by passing a ribbed roller over it and then subjecting a substantial portion of the area of the surface of the glass to pressure between dies having flat or uncorrugated surfaces thereby effecting a substantial equal spreading of the ribs in all directions to form a substantially flat or uncorrugated surface on both sides of the sheet or plate.

48. Wadsworth, 844,552, February 19, 1907.

The method of making glass sheets consists in forming two sheets of glass out of contact with each other and bringing their surfaces into welding contact with each other upon interposed metal mesh only after they are brought to sheet form and when their temperature has been appreciably reduced, and then compressing the composite sheet over substantially its entire surface.

49. Will appear with cut in October issue.

50. Arbogast, 844,767, February 19, 1907.

The method of making wire-glass consists in assembling two layers of glass with an interposed layer of wire mesh, then subjecting the assembled glass and wire mesh to a gradually-increasing temperature sufficient to fuse the glass together while retaining the individuality of the layers and their transparent quality, then subjecting the product to a gradually-decreasing heat.

51. Baldwin, 847,637, March 19, 1907.

The method of making wire-glass consists in disposing a preliminary sheet of glass having a wire fabric on one side, in juxtaposition to a rolling surface with the wired surface of the sheet, next to but spaced from the rolling-surface, depositing on the rolling surface against the wired surface of the sheet a mass of plastic glass, and simultaneously rolling the sheet and plastic mass upon the rolling-surface, whereby a homogeneous sheet of glass is formed with the wired fabric embedded therein.

(To be continued)

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Further Progress in Raw Materials of the Glass Industry

Marked development has been made in the standardization and manufacture of raw materials entering into the glass batch. This phase of glass manufacture has therefore almost ceased to exist as a worry amongst glass workers. Particularly is this true of the most important ingredients. Materials such as sand, soda ash, borax, zinc oxide, salt cake, etc., may now be purchased from any reliable source with extreme confidence and knowledge that the minimum of impurities are contained therein; that the grain size and analysis will run uniform. The situation regarding material of the above type may be regarded without any apprehension, simply because it is known that they are required to pass certain chemical and physical tests which in turn are controlled by chemical laboratories operated by competent chemists.

Great progress has been made and is being made in another material used to a great extent by the glassmaker. We refer to feldspar. In the not too distant past, this important glass making material was mined and offered to the trade in a more or less "rule of thumb" method. With the advent of a chemical control laboratory by one of the leading feldspar producers just a few years ago, the first definite step was taken to bring this natural commodity to the same plane of standardization with other basic materials now in use. Some time after the establishment of this laboratory, other feldspar producers saw the advantage of involving the expense of maintaining laboratories. That this wisdom was justified by the pioneer was shown by the marked progress in sales of their feldspar and the establishment and maintenance of laboratories by other feldspar producers. So widespread had the belief in control of feldspar through chemical science become that there soon followed intensive research programs, and establishment of fellowships until today the mining, use, grading and classification of the various spars are well known to nearly all miners of same.

In the same spirit of coöperation which has marked all progress and development in this country, the various interests representing the feldspar industry have banded themselves together in an organization which has recently been announced as the Feldspar Grinders Institute. This organization we understand will attempt to further simplify and standardize feldspar mining operation. The glass industry awaits with interest any new development tending to simplify glass practice and we therefore believe the work of the Feldspar Grinders Institute will be watched with interest. We congratulate the members of the Institute and wish them the greatest success in their undertaking.

English Potters Combine

The tendency in the ceramic industry towards forming combinations of manufacturers is not confined to this country alone. Twenty of the largest pottery concerns in England recently announced their amalgamation to go into force in September. The new organization will be known as the English China Corporation. Ltd., and will have a capital equal to $5,000,000. A plant planned on modern and economical lines will be built. When this large central plant is completed a number of less efficient plants will be closed.

Feldspar in North Carolina

by R. Carl Moore[1]

Within a radius of a few miles near the point in Western North Carolina where the Black Mountains with their line of tall peaks jut into the Blue Ridge over half of the feldspar annually produced in the United States is mined. The yearly production of this region is in excess of 100,000 tons of crude feldspar, of which a very large proportion goes into the glassmaking industry, and the mining and grinding of this quantity of ore calls for the employment of large amounts of capital and large numbers of experienced operators, chemists, and skilled workmen.

An occurrence of great importance in this region during the past two years has been the steady movement of grinding plants into North Carolina. For a number of years North Carolina has led the country in the production of crude feldspar, but the bulk of this has been shipped outside the state for grinding. However, there are at the present time five feldspar grinding plants in operation in this territory. In order of their establishment, they are:

North State Feldspar Corporation, Micaville, N. C.....	1924
Tennessee Mineral Products Corp., Spruce Pine, N. C.....	1927
Golding Sons Company, Spruce Pine, N. C.....	1928
Feldspar Milling Company, Micaville, N. C.....	1929
Southern Feldspar Company, Toe Cane, N. C.....	1929

With these five plants in operation, it is practically certain that North Carolina will this year take first place in the grinding as well as in the mining field.

Feldspar—frequently called spar—usually occurs as narrow veins in pegmatite dikes. These veins are frequently only a few feet in width but sometimes hundreds of feet in length. These dikes were formed ages ago by the intrusion of fluid material between confining walls of other rocks. Occasionally the veins of feldspar expand into pockets; frequently they terminate abruptly or become so shot through with foreign material as to be commercially valueless, thus rendering mining hazardous financially, especially to the beginner. Mining is also made difficult by the rough and rugged topography of the country, which frequently necessitates the construction of miles of railroad to promising deposits. There are also in this mining field large investments in tramways, aerial cableways, truck and wagon roads, as well as in expensive mining equipment, such as steam or electric drills, hoists, mine cars, and the like. Extensive hand labor is occasioned by the presence of foreign substances, such as mica, garnet, etc., which would ruin the spar if allowed to remain. Iron is very injurious. Competent hand selection of spar at the mines is thus of paramount importance. To such an extent is this carried on that in even the best mines the bulk of the ore mined is usually discarded as waste, while in the average mine the percentage so discarded is much greater.

Most of the large companies now own or control a large proportion of their supply of crude feldspar. This is a great help in maintaining a spar of unvarying uniformity, and also insures an adequate supply of raw material in case of prolonged spells of bad weather, when the supply of purchased spar might fail. In addition to the company mines, there are in Western North Carolina a number of large independent producers and hundreds of smaller producers who sell their output to the various mills. Some underground spar mining is carried on, but the great majority of mines are of the open pit type.

Another event of importance to the feldspar manufacturer and consumer alike has been the gradual tightening of the chemical control maintained over the feldspar placed upon the market; this has caused an expansion of laboratory facilities and an increased employment of chemists. Unlike many of the ceramic plants which frequently use the analysis merely as an index and make the fusion point of the spar the final test, the glass manufacturer must depend upon the analysis almost entirely. The average feldspar manufacturer is now prepared to furnish analyses whenever desired and to supply a uniform product. A fair analysis of North Carolina feldspar going into the glass trade is as follows:

Silica	69.00
Alumina	18.00
Potash	9.80
Soda	2.70
Calcium oxide	.35
Iron oxide	.10
Magnesia	Trace

As feldspar is used by the glassmaker mainly for the alumina it contains it is of course important to keep this element as large as possible and the silica content down. Iron should not run more than .1 except in spar used for amber glass. There are grades of spar that contain a larger proportion of soda than potash, but these are the exception; the great bulk of North Carolina glass spar sold is of the potash grade.

The milling of feldspar has been carried to a high state of efficiency. From the time that the crude material, after a final selection at the mill, is dumped into the crushers it is handled entirely by machinery. After being broken into small pieces by the crushers, it is run through revolving pebble mills and reduced to the desired mesh. The great proportion of glass spar is ground to 20 mesh, although some plants require as high as 90 mesh. The finer grades are usually run through an air separator, while the coarser meshes receive their final sizing over vibrating screens. Most of the feldspar is shipped in bulk, although some is shipped in bags. For bag shipments the paper bag is now gradually supplanting the burlap bag.

With a constantly expanding mining field, a greatly increased grinding capacity, and with a steadily increasing demand for feldspar, North Carolina seems to be in position to be of even greater service to the glass manufacturer in the future than in the past.

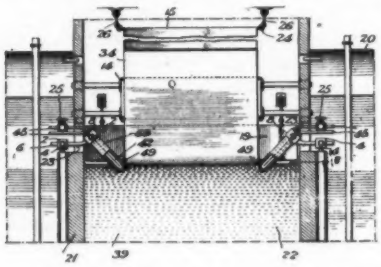
[1] North State Feldspar Corporation.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

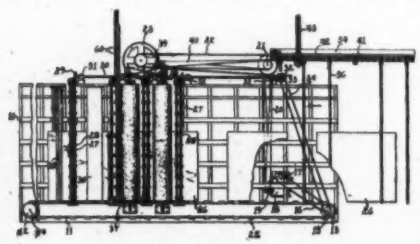
Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

APPARATUS FOR DRAWING GLASS. U. S. 1,722,483. July 30, 1929. Arthur E. Spinasse, Mount Vernon, O. Original application filed 1/10/28. Divided and this application filed 5/4/29. In an apparatus for drawing sheet glass wherein the sheet is drawn upwardly from a bath of molten glass, means for forming and maintaining cooler areas of viscous glass as sources from which the edge portions of the sheet are drawn, comprising a pair of internally water-cooled members projecting downwardly into the molten bath, and sheathings of refractory material for the portions of the members within the molten bath, said water-cooled members and sheathings therefor being disposed substantially in a plane containing the drawn sheet, and of such dimension as to localize the cooling effect upon the molten glass at the edges of the sheet for thinning said edges of the sheet and maintaining the width of the sheet.

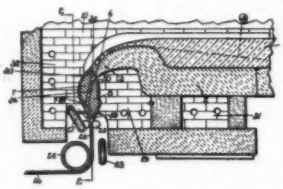


LENS-GRINDING MACHINERY. U. S. 1,721,161. Albert E. Maynard, Southbridge, Mass., assignor to American Optical Company. Filed 3/23/25. In a device of the character described, a supporting arm having a boss with a bore for a bearing, the axis of the bore being substantially normal to the support, a lens clamp bearing slidably and rotatably mounted in the bore and having a resilient lens contacting face, means for holding the bearing in the bore and limiting its sliding movement therein, resilient means in the bore engaging the bearing and tending to urge the bearing in lens engaging direction, a second support separated from and substantially parallel with the first support and having a boss with a bore, the axis of which is aligned with the axis of the first bore when the supports are in lens engaging position, a lens clamp bearing in the second bore rotatably mounted therein and having a resilient lens contact face and having interengaging means by which it may be engaged with the drive shaft of a lens edging machine, means for holding said bearing in its bore, means connecting the two supports whereby the distance between them at the lens engaging position may be changed, and means for locking the two supports in the lens engaging position.

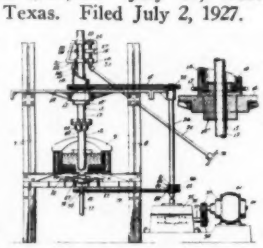
MEANS FOR HANDLING PLATE GLASS. U. S. 1,723,148. Aug. 6, 1929. Ival G. Fowler, Toledo, O., assignor to The Edward Ford Plate Glass Company. Filed 7/20/27. A machine provided for scrubbing and drying the plates as they are carried therethrough in an approximately vertical position, both sides of the plate being treated simultaneously. As the plates leave this machine they are received by a suitable conveying device and carried to the cutting table, during which travel they are examined and marked for defects, quality and the like. As the plates reach the cutting table, they are removed from the conveying device and are fed beneath the cutters, which will be adjusted to cut the plates in accordance with the marking thereon. Among the inventor's claims is a combination with means for feeding a glass plate longitudinally and for a traveling conveyor provided with means for supporting said plates in a substantially vertical position while it is being conveyed thereby, the orbit of said conveyor being such as to bring said supporting means into co-operative relation to the feeding means so as to receive the plate by gravity as it is delivered by said feeding means and to convey it therefrom.



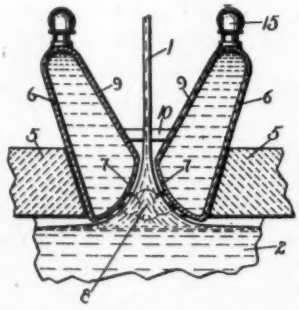
METHOD AND APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,720,547. July 9, 1929. Enoch T. Ferngren, Toledo, O., assignor to The Libbey-Owens Sheet Glass Company. Filed 5/15/24. According to this invention, molten glass flows from a pool in a uniform shallow stream over a lip at one side of the container onto and around a pair of metallic directing or controlling members, from the lower edge of which the glass is drawn downwardly in sheet form and then deflected into a horizontal plane. Means are provided for controlling the temperature of the several streams of glass flowing onto, around and between the pair of directing members, in such a manner that the outer stream which has its source in the upper portion of the flow over the lip is rendered cooler and more tenacious so that it bears the greater portion of the drawing stresses, whereas the innermost stream, formed from the glass flowing in contact with the lip, is in a much hotter and more fluid condition, and is under no appreciable drawing strain.



GLASS-CHARGING DEVICE. U. S. 1,720,496. July 17, 1929. Albert F. Tremblay, Three Rivers, Texas. Filed July 2, 1927. A charge forming device comprising a plunger, a rotary cam concentric with the plunger, a yoke concentric with the plunger and having a roller for riding on said cam, said yoke being slidably mounted with respect to the plunger and cam, a nut having means whereby it may be secured at any one of a number of points on said plunger, a screw arranged through said nut and being mounted for rotary movement in said yoke but restrained from axial sliding movement, and means connected to said screw for rotating the same to adjust the yoke.

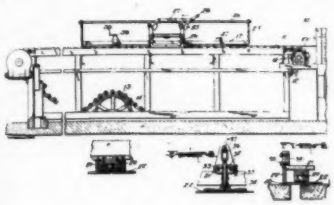


DRAWING SHEET GLASS. U. S. 1,720,527. July 9, 1929. Clifford A. Rowley, Toledo, O., assignor to The Libbey-Owens Sheet Glass Company. Filed 3/24/24. A rather highly heated mass of molten glass is maintained in a comparatively deep receptacle, the upper surface of the pool being entirely covered over except for a comparatively narrow surface strip from which the glass sheet is drawn upwardly. The passage through which the sheet is drawn upwardly is surrounded by a metallic cooling member of loop form which is positioned closely adjacent to the base of the sheet and the "meniscus" or upwardly sloping mass of glass pulled up by the glass sheet. The side portions of this cooler loop are of comparatively large cross-section so as to be able to withdraw a considerable amount of heat from the forming sheet, whereby a sheet source of high temperature can be quickly reduced to a sufficiently plastic condition to be drawn rapidly into sheet form. The end portions of the cooler loop are of smaller capacity, but the sides thereof are arranged more closely adjacent one another to provide a much narrower passage there-



between, through which the edge portions of the sheet are drawn upwardly in direct contact therewith. Preferably the central portion of the sheet does not directly contact with the coolers positioned at the sides thereof, although these coolers may be so proportioned as to have direct contact with the sheet source.

GLASS-CUTTING APPARATUS. U. S. 1,720,546. July 17, 1929. John L. Drake, Toledo, O., assignor to The Libbey-Owens Sheet Glass Company. Filed 1/30/25.

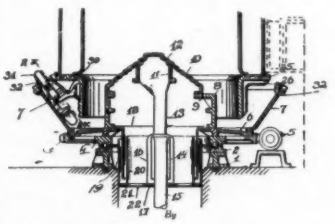


Object of the invention is to provide an apparatus for the cutting of glass wherein the sheet is scored transversely thereof parallel to the preceding cut.

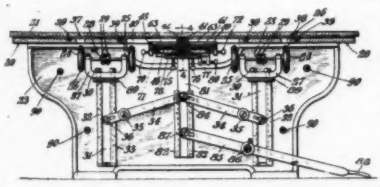
To provide a cutting mechanism wherein a saving of glass will be accomplished by cutting the glass in sheet lengths in a manner that both ends of the sheet will be parallel to each other.

To cut a sheet from the ribbon, the frame is tilted upwardly and slid to stationary support until the fingers are above the cut end of the sheet after which the frame is lowered so that the said fingers will abut the said end. The frictional engaging means are then lowered into position by operating the lever to permit the said feet to move downwardly by action of the springs. After the sheet and frame are frictionally engaged to prevent relative movement a guiding mechanism is adjusted for the length of sheet desired, after which the scoring implement or cutter may be moved through the slot to properly score the sheet.

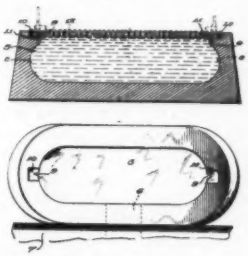
ASH REMOVER FOR PRODUCER GAS GENERATORS. U. S. 1,719,519. July 2, 1929. Arthur R. Pulver, of Adams Basin, N. Y. Filed 4/17/28. A rotating ash pan having a vertical axis, a fixed support above the pan, an ash impeller mounted to rotate on said fixed support, said impeller being located in the pan but being independent thereof and having a plurality of spokes thereon, said spokes being cup shaped on the upper side and being adapted to lift ashes out of the pan, means for rotating said impeller to lift ashes out of the pan as the pan rotates to bring ashes to the impeller, said impeller and its axis being inclined, the upper part of the impeller overhanging the outer edge of the pan.



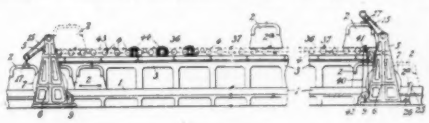
PROCESS OF SEVERING GLASS OR THE LIKE. U. S. 1,719,588. July 2, 1929. Fyrman N. Campbell, of New Haven, and Jules Myatt, of East Haven, Conn., assignors to Bessie L. Gregg. Filed 11/27/26. A process of severing glass along a defined line by applying heat to the zone of such line and controlling the distribution of such heat, and other conditions, in a manner whereby controlled expansion takes place and the glass is accurately severed at the desired line. Such heat applied by bringing a hot object or objects or elements, heated electrically or otherwise, into contact with or into close proximity of the glass, but if desired, according to certain phases of the invention, heat may be provided by the combustion of oxidizable material placed along the line of cleavage, or by other suitable chemical action. Process of severing glass or the like along a predetermined line which comprises supporting the glass at points spaced from said line, forming a fault in the edge of the glass at said line, bringing a heated wire into close proximity of the under side of the glass and along said line, and providing additional heating means along the zone of said line for controlling the radiation within the glass of heat from said wire. Process of severing glass along a pre-determined defined line, which comprises warming the surface of the glass at least over a zone including said line, and heating the glass at said line to a temperature sufficient to cause controlled cracking at said line before the interior of the glass of said zone is warmed, said warm area extending substantially beyond the area directly heated by the application of heat at said line.



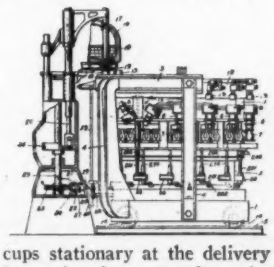
SHEET-GLASS-DRAWING APPARATUS. U. S. 1,722,445. July 30, 1929. George G. Roberts, Arlington County, Va., assignor to Virginia Plate Glass Corporation. Filed 1/27/27. In that type of sheet-glass-making in which the sheet of glass is drawn in the flat from a molten mass of glass by means of a bait-bar which is dipped into the molten glass and slowly drawn upwardly therefrom, the bait has been made slightly shorter than the distance between the drawing edges or corners of the crucible or nozzle. This naturally brought about a slight tendency of the edges of the sheet to pull inwardly, with the result that, as the sheet lengthened, this pull became so great as to finally pull the edges of the sheet away from the drawing corners or edges. This pulling-in tendency is avoided the inventor claims by so relatively constructing the bait and the crucible that there will always be more or less of a tendency to pull outwardly on the edges of the sheet. The inventor claims a crucible for drawing plate-glass having an elongated opening with a drawing-corner at each end, determining the width of the sheet, pockets being formed in the upper surface of the crucible at each of said drawing-corners, said pockets extending outwardly away from said corners and being wider than the sheet to be drawn, so that molten glass may flow into the pockets during the drawing of the sheet, and a glass-melting furnace connected by a passageway with said crucible to deliver glass thereinto, said pockets being so positioned with reference to the level of glass in the furnace that glass will flow into the pockets by gravity while the sheet is being drawn.



APPARATUS FOR POLISHING GLASS. U. S. 1,716,819. June 11, 1929. Charles Heuze, Auvelais, Belgium. Filed 9/21/27 and in Great Britain 9/25/26. In apparatus for the continuous polishing of glass in which both the glass carrying tables and the polishing runners travel, a conveyor located above the polishing apparatus and adapted to convey the runners from the finish to the start of their operative course, a lifting device at the finishing end adapted to lift each runner off the tables and deposit it on the conveyor, comprising a pivoted lifting arm which is oscillated from a position on one side of its upper dead centre to a position on the other side thereof, a similar lifting device at the starting end adapted to lift each runner off the conveyor and deposit it over the tables and a felt cleaning device adapted to clean the felts of each runner during its travel on the conveyor.



GLASS-FORMING MACHINE. U. S. 1,689,975. Oct. 30, 1928. Theodore H. Sloan, Charleroi, Pa., assignor to Macbeth-Evans Glass Co Filed 10/12/26. In a glass-forming machine, the combination with a source of supply adapted to deliver glass, of a frame, a continuously rotating turret provided with a plurality of forming units continuously movable with it, a plurality of glass-receiving cups borne by said turret and movable with the turret each in registration with a forming unit, means borne by said frame for successively engaging and holding each of said cups stationary at the delivery station to receive glass, and means borne by the turret for subsequently causing each cup to move with the turret in registration with a succeeding forming unit.



The Glass World and What It Is Doing

News of the Industry

American Company Formed to Control Bicheroux Process in This Country

The American Bicheroux Company, recently formed under the laws of the State of Delaware, has acquired all the United States rights of Maatschappy tot Beheer en Exploitatie van Octrooien of The Hague, Holland, in patents and applications relating to the well-known Bicheroux process[1] of rolling sheet and plate glass and to handling, and lehring the sheets after rolling, together with licenses heretofore granted by the Dutch company to The Edward Ford Plate Glass Company, The National Plate Glass Company, Libbey-Owens Glass Company, and the Blue Ridge Glass Corporation.

In addition to the Maatschappy rights, The American Company has acquired rights from Société Anonyme des Manufactures des Glaces & Produits Chimiques de Saint-Gobain, Chauny & Cirey of Paris, France, Charles Heuze of Auvelais, Belgium, and several other European inventors under applications directed to the same ends.

The Edward Ford Plate Glass Company has been operating under its license for some months with great success, and The National Plate Glass Company expects to start rolling glass under its license about the end of August at the plant it has erected for that purpose at Ottawa, Ill.

The officers of The American Bicheroux Company are: Chairman of the Board, Max Bicheroux; president, H. J. Eckenrode, president of The National Plate Glass Company; vice-president, James C. Blair, president of the Libbey-Owens Glass Company; treasurer, Leslie V. Christy of General Motors Corporation, and secretary and patent counsel, V. M. Dorsey of Washington, D. C.

The directors include, in addition to Messrs. Eckenrode, Blair, Dorsey and Bicheroux, James McEvoy of General Motors Corporation, H. H. Baker of the Libbey-Owens Glass Company, A. D. Falck of Corning Glass Works and the Blue Ridge Glass Corporation.

[1] Earlier developments of the Bicheroux process have been described and illustrated and predictions made as to its success in this country several years ago in THE GLASS INDUSTRY. See the following issues: July 1927, pp. 158, 167; Sept. 1927, p. 207; Oct. 1927, p. 231; Nov. 1927, p. 276; Dec. 1928, pp. 267, 275.

The Recent Glassware Manufacturers' Meeting

A report by our representative who attended the July 15 meeting of the American Glassware Manufacturers at Atlantic City, prepared shortly after the meeting, was inadvertently omitted from the August issue, due to a printer's error. It seems advisable to give in this issue a brief summary of the proceedings of the association on that occasion.

C. M. Rodefer, the retiring president, opened the meeting. The annual election resulted in the elevation of George Dougherty, president and treasurer of the Morgantown Glass Works to the presidency.

Mr. Dougherty objected strenuously to being nominated as president. He intimated that he held the view that the Association should possess a more militant spirit and that if elected he might be tempted to advocate the inauguration of policies that would stir up the Association from its present placid state and divert the members' efforts into more active channels and that some of his ideas might not be approved by the more conservative members. However, the members present insisted on putting through his nomination and election.

W. T. Gillender, president of Gillender Bros., Inc., was re-elected vice-president and E. P. Ebberts, secretary and treasurer of the Phoenix Glass Company was reinstalled as treasurer. Victor G. Wicke, president and general manager of the Imperial Glass Company was elected second vice-president to fill the vacancy caused by Mr. Dougherty's election to the higher office. John Kunzler, as was to be expected in view of his long service with the organization, was reelected actuary.

President Rodefer in his annual report referred to the tariff and called attention to the forthcoming census. He appealed to the manufacturers to give the desired information to the Census Bureau promptly and accurately and cooperate in every way possible in adding to the value of the final census figures. He discussed packing charges and the question of establishing charges for two types of cartons, and a motion made to authorize this change was passed. Mr. Kunzler read the report of the treasurer, E. P. Ebberts, who was not present.

C. B. Roe, president of the Fostoria Glass Company and chairman of the Tariff Committee of the Glass Manufacturers Association outlined the work which had been accomplished in Washington in presenting the glass manufacturers' case to the House Ways and Means Committee. He also referred to the work of the committee before the Senate Finance Committee on the new tariff bill now under consideration by that body.

Thomas W. McCreary, general manager of Phoenix Glass Company, spoke very earnestly on the tariff question, and described his activities in connection with the appeal made to the Senate subcommittee by the Illuminating Guild. He declared that the tariff as now imposed on imported glass products coming from countries where wages are low and living conditions far below the United States standard was a discrimination against Canada and other nations whose industries pay living wages. He also deplored the lack of organization and cooperative action on the part of the several divisions of the glass industry, particularly in tariff matters. He suggested a standing tariff committee to watch tariff matters at all times instead of only on special occasions, as at present, when the enacting of a new tariff bill is pending.

Among the visitors and speakers at the meeting was S. G. Garnsworthy, secretary of the Australian Glass Manufacturers Company, Ltd., of Melbourne, Australia.

Colored Glass and Fancy Names Sell Food in School Restaurant

Varying colors and attractive names for food have been discovered to be the biggest influences in the sale of foods by the council in charge of the Smedley High School restaurant of Chester, Pa. Colors not only built up the restaurant, although it is operated on a non-profit basis, but it is holding up its patronage against rival stores outside the school yard, according to *Woman's Home Companion*. Whereas before the color experiment was started, pupils spent ten cents out of every dollar of their lunch money for brightly colored sweets, they now spend but five cents. A still more important discovery is that the pupils are choosing, of their own free will, the foods that make up a balanced ration.

During the early days of the experiment, the directors of the lunch room discovered that milk served plain did not sell so well. On the following day, when served in amber glasses, the sales shot up. When the amber glasses were used several days in succession fewer pupils bought it and accordingly a change of color in the glasses sent the sales back up. On St. Patrick's day a tiny shamrock was stuck into the cap of each bottle and the supply was sold out before the lunch hour was over. When the director wants to feature stewed or sliced fruit, she serves it in green glass cups. It is one of the deserts the pupils consider too tasteless to buy.

Lettuce sandwiches were passed by scornfully for ham sandwiches, but when the director wrapped them in green waxed paper, the number of lettuce and ham sandwiches sold were exactly reversed. Corn starch pudding, too, failed for several days to attract customers even at five cents a dish until the color scheme was tried out. The dessert was offered in white saucers at the first noon recess period and the youngsters had eyes only for the colored ice cream. During the next two inter-

missions, the women behind the counter could not empty corn starch into green sherbet cups fast enough to keep up with the demand.

Names likewise helped popularize foods the pupils should have eaten. Tomato soup was the general favorite, probably because of its color, but when clam chowder appeared under the name Treasure Island Chow, sales rose to spectacular heights. Baked apple as a dessert did not sell of itself, but with a scoop of ice cream and named Happy-go-lucky, another sell-out was recorded. A salad of apples, raisins and celery failed to move until labeled Collegiate Salad.

The school restaurant was built up from a dingy failure through the aid of the National Dairy Council, which laid the foundation for its success by first decorating the room in attractive colors and then proposing the color sales scheme.

Earnings of the Recent Glass Merger Set at Two Million

Earnings of the Owens-Illinois Glass Company which represents the combined interests of the Owens Bottle Company of Toledo and the Illinois Glass Company of Alton, Ill.; merged six months ago have totaled for that period the amount, $2,212,657. This statement was announced by President W. H. Boshart, August 19. As pointed out by the *Toledo Bee* the total income in the first six months was $5,105,510, of which more than $2,000,000 was profit after deduction of general overhead, depreciation and federal income tax. Since July 1, loans which were obtained when the assets of the Illinois Glass Company were acquired have been repaid and now the cash and government securities on hand exceed $4,000,000. Manufacturing profit and royalty for the first six months exceeded $4,000,000 and net earnings before the deduction of the $282,975 federal income tax, amounted to $2,495,632. General selling and miscellaneous expense was $2,699,878. Although the work of the combined corporations has progressed with rapid strides and the advantages of the consolidation largely have begun to appear there still is considerable work to be done before the full effect of the undertaking can be determined, said Mr. Boshart. Future periods are expected to reflect large economies as large reductions are to be made in expenses. Operations are being concentrated in the plants best suited for serving the trade and the less profitable units are being discontinued. Sales volumes are very good and indications are for a good year in the condiment bottle business. New lines are being developed and new sales territories are being opened as a result of the combined operations. Subsidiary companies acquired in the merger include the Chicago Heights Bottle Company, the Carlyle Paper Company, Tavern Rock Sand Company and the Madison Warehouse Company.

July Construction Record

Total construction contracts awarded during July in the 37 states east of the Rocky Mountains amounted to $652,436,100, according to the F. W. Dodge Corporation. These states include about 91 per cent of the total construction volume of the country. This was the second largest monthly total on record and represented an increase of 12 per cent over the total for July, 1928, and an increase of 20 per cent over that for June, 1929.

Glass Dealer Alleges Plot Against His Life

Steps were recently taken to institute a suit in the Supreme Court for $500,000 damages and costs in favor of Jacob Okonowitz of the Borough of the Bronx, New York City, against nine individuals and six corporations whom he accused of conspiring to take his life because he refused to accede to their demands and join a glaziers' union. Several attempts were made on the plaintiff's life and he was twice shot at and wounded. One of the defendants, in the case, William Ellinger of Brooklyn, was convicted for the second shooting and is now serving a sentence of from 5 to 10 years in Sing Sing. Besides Ellinger the co-defendents are:

Simon Albert, Brooklyn; A. & F. Plate Glass Co., Inc.; Harry J. Goldman, Brooklyn; Lenox Glass Co., Inc.; Joseph Rosenblum, Mount Vernon; White Pine Sash Co., Inc.; Hyman Spitzer, Advance Shade & Glass Co., Inc., Barney C. Herman, Capitol Glass Co., Inc., Samuel Resnik, Resnik Brothers Glass Corp., Jacob B. Glaston, Jacob Rappaport.

Okonowitz at the time of the first shooting in January, 1928, was president of the Federal Glass Company. William Ellinger is accused of having been hired by the other defendants and instructed "to remove the plaintiff from the market as an active trader in the manufacture and selling of glazed sash." The plaintiff who has a wife and four children is reported to have given up his business because of the plot against his life.

New Belgian Fourcault Plant

The Compagnie Internationale pour la Fabrication Mecanique du Verre, a Belgian glass plant, has announced an increase of capital from 66,000,000 francs to 100,000,000 francs, par at $0.0278, Assistant Commercial Attache Leigh W. Hunt, Brussels, reports to the Department of Commerce. This increase in capital is declared required for the development of the firm's production in Belgium. This firm is now producing in the Moll installations 12,000,000 square meters of glass annually with 12 machines.

A new plant is now being erected in the Mons region which will have an annual capacity of 6,000,000 square meters when equipped with its full quota of six machines. The initial equipment of the new factory will consist of only four machines.

Glass Division Committees

The organization of the Glass Division of the American Ceramic Society for the current year is as follows:

Chairman, J. T. Littleton; Vice Chairman, E. W. Washburn; Secretary, G. W. Morey.

Research, F. C. Flint; Standards: a. Tests, G. E. F. Lundell, b. Products, W. C. Tablor.

Data, R. J. Montgomery; Membership, G. W. Cooper; Rules, F. C. Flint; Education, J. C. Hostetter; Nominations, A. Silverman and E. W. Tillotson; Papers and Program, S. R. Scholes; Trustee, C. D. Spencer.

Plate Glass Production in July

According to figures compiled by Secretary P. A. Hughes of the Plate Glass Manufacturers Association, the production of polished plate glass for the month of July, 1929, was 13,057,098 square feet, as compared with 12,278,002 square feet produced in the preceding month, June, 1929, and 9,966,349 square feet produced in the corresponding month last year, July, 1928.

To Export Abrasives

The Durex Abrasive Corporation has filed papers under the export trade act (Webb-Pomerene law) with the Federal Trade Commission, for exporting abrasive products, the Commission announced July 9. The Association will maintain offices at 82 Beaver Street, New York.

Decrease in Canadian Glass Production

Production of glass in Canada according to the Dominion Bureau of Statistics during 1928 was valued at $13,765,354, about 2% less than that of the 1927 production. Capital employed in the industry in 1928 amounted to $12,694,882.

Trade Activities

The Acme Glass Company's storage and packing house on Reed Street, Olean, N. Y., was destroyed by fire early in August.

The Standard American Glass Corporation, Wilmington, Del. was recently incorporated with 250,000 shares of common stock.

The Grand River Glass Company, Detroit, Mich.; will erect a two-story factory building. The architect is Walter Hamacher.

T. A. Calhoun, one of the important officials of the Triplex Safety Glass Company of North America, New York, since its organization in 1926, has resigned.

The Atlantic Glass Corporation, of which Albert Schoeller of Trenton, N. J., is president, is reported to have purchased a plot of several acres of land at Hightstown, N. J., on which it is planned to erect a new glass plant.

Gruenberg Company, 318 W. Illinois St., Chicago, has been incorporated to handle glass products. H. H. Gruenberg is at the head of the organization.

The Monongah Glass Company, Fairmont, W. Va., it is said, will spend approximately $100,000 on improving their local plant and increasing their capacity.

The American Window Glass Company has declared its regular semi-annual dividend of 3½% on the preferred stock, payable September 3 to record of August 21.

The Long Beach Glass Company, Long Beach, Cal.; is reported to have purchased twelve acres from the Montana Land Company, for a site for a new glass factory.

The Cameron Glass Company, Cameron, W. Va.; which had been closed down for several weeks, during which time a new tank was built and other repairs made, resumed operations early in August.

The Owens-Illinois Glass and the Libbey-Owens Glass Companies, it is reported will join in erecting a twenty-five-mile pipe line to cost $500,000 from Wayne County, W. Va. to their two plants at Charleston, W. Va.

Krell Glass Company, St. Louis, Mo., has been incorporated with a capital stock of $40,000. The incorporators are O. P. Krell, 9015 Sherwood Place, St. Louis, Mo., and C. H. Harding, 8015 24th St., Fort Smith, Ark.

The Pittsburgh Plate Glass Company is reported to have awarded a contract for the construction of the main building of its large new plate glass factory at Santa Ana, Cal., to Stone and Webster, through their Los Angeles offices. The contract covers a one-story building 400 x 2600 feet in size.

The Cambridge Glass Company, Cambridge, O., manufacturers of pressed and blown glassware and specialties, recently erected a new restaurant building for the convenience of its employes, the factory being located some distance from the center of the city. Another important improvement is the installation of a new air cooling system.

Libbey-Owens Glass Company stock was listed on the New York Stock Exchange August 8 at a tentative figure of $43 a share. There are 1,772,052 shares of the new stock which was recently issued on the basis of 4 shares for each share of old stock turned in by stockholders. The old stock was dealt in on the curb at between $150 and $160.

The Indiana Building Congress and Trade Show, sponsored by the organized building industry of the State of Indiana, and headed by Merritt Harrison, leading Indianapolis architect, will be held at the State Fair Grounds in Indianapolis during the week of October 21 to 26, inclusive. One great purpose of the Congress is to aid in the stability of the building industry of the State.

The Australian Glass Manufacturers Company, Ltd., Sydney, Australia; recently announced that equipment is being installed for the beginning of operations in about one year on production of window glass. The new works is estimated to cost approximately $1,000,000 with annual production capacity planned for 15,000,000 to 20,000,000 square feet of plain window glass.

The Capital Glass Company, Cameron, W. Va.; has been incorporated with a capital of $100,000. The new company will make a general line of glassware and will probably take over the former Perfect Glass Company plant. The incorporators are R. L. Hutchinson, C. M. Hutchinson, J. Cecil Fee, of Wheeling, A. A. Van Dyne of Moundsville, and James P. Madden of Cambridge, O.

Irwin S. Chanin, president of the Chanin Construction Company of New York which has eercted several tower office buildings in that city has gone to Europe where he will investigate the possibility of using glass, including glass brick, as extensively as possible in the construction of a new 65-story building planned to be erected at the present site of the Century Theatre on Central Park West.

The Brockway Machine Bottle Company, Brockway, Pa., held its annual meeting late in July at Olean, N. Y. Directors were elected as follows: P. J. Spindler, A. A. McFadden, J. W. Harding, Theo. McVihl, W. C. Mix, D. R. Cox, and Robert Warren. Robert Warren was elected President; J. W. Harding, Vice President; W. D. Dugan, Secretary and Auditor; A. A. McFadden, Treasurer and Manager.

The American Ceramic Society is cooperating with the Ceramic Society of England in celebrating the Wedgwood Bicentenary, the date for which is fixed for the week of May 19, 1930, at Stoke-on-Trent. Just what form the participation of the American Ceramic Society will take in the celebration has not yet been officially determined. Dr. J. W. Mellor and W. J. Gardner, formerly president of the Society of Glass Technology, are active in organizing the affair.

The Fry Glass Company, Rochester, Pa. has been reorganized, the reorganization committee having completed its work on August 1, at which time the receivership was brought to a close. The following officers were elected. Chairman, John W. Ailee, Pittsburgh; President, S. C. Stebbins, Lansing, Mich.; Vice-President, G. K. Fry, Rochester, Pa., Secretary, Edward T. Davies, Rochester, and Treasurer, William A. Mitchener, Rochester. Many new and attractive lines of stemware and tableware are expected to be produced by the company under its new organization. They also plan to extend their sales activities throughout the United States and Canada in a more intensive manner.

The American Window Glass Company recently announced the promotion of H. F. Clark, who has been superintendent of the Belle Vernon, Pa. plant, to be general manager of the Arnold, Pa. plant. It was under Mr. Clark's supervision that the successful installation of the Fourcault system at Belle Vernon to replace the old cylinder process was effected. His activities at the Arnold plant will be along the same lines, where a similar change of processes is being made. Norman L. Neice of the Belle Vernon plant will succeed Mr. Clark as superintendent. It has been planned to resume operations in this plant, which has been closed for cold repairs, some time during August.

The American Window Glass Company's proposal to convert 130,000 shares of the present common capital stock of the company par value $100 into 70,000 of Class A stock of par value $100 and for 30,000 shares of common stock of no par value was voted on at a special meeting of the stockholders held July 30. Out of a total of 170,000 shares of stock outstanding an overwhelming majority voted in favor of the proposition and only 20 shares voted against it. A special meeting of the stockholders of the American Window Glass Machine Company to vote on the exchange of its stock for stock of the American Window Glass Company and for winding up the affairs of the American Window Glass Machine Company is to be held on September 16. It is said that a large majority of the stockholders are in favor of the proposition, giving assurance that the plan will be carried into effect.

The Hazel-Atlas Glass Company, Wheeling, W. Va.; have announced their plans to establish a new plant unit at Oakland, Cal.; to be known as the Atlas Glass Company, Ltd., and which will manufacture a line of glassware used exclusively in the Pacific Coast fruit packing industry. Articles of incorporation have been filed. The plant will probably employ between 100 and 150 workers and it is said will be a one-furnace factory equipped with six blowing machines. The chief purpose of the new plant is to expedite deliveries to California packers on glass products that are now shipped by the Panama Canal route. This improved service will better enable the Hazel-Atlas sales organization to meet competition coming from various California glass manufacturing plants. In moving to erect this new plant, it is understood that the Hazel-Atlas management had in mind the future possibilities of the West Coast trade where demand for products of local plants has been increasing steadily. With a production unit in this trade territory the company will be prepared to make such plant additions from time to time as business requires.

Recent Deaths

Adam Isaac Duval

Adam Isaac Duval, retired glass manufacturer died July 27, at Huntington, W. Va., at the age of 70, after a short illness. He was buried at Findlay, O.

Luther B. McMillan

The recent death of Luther B. McMillan, for thirteen years general consulting engineer of the Johns-Manville Corporation, engineering science has lost one of its outstanding personalities.

Mr. McMillan died on August 10 at the St. James Hospital, Newark, N. J., from injuries received in an aeroplane accident the evening before when the plane in which he was accustomed

to travel between the Newark Metropolitan Airport and Manville, N. J., went into a spin and fell into marshy ground near the airport.

Mr. McMillan was born at Bem, Missouri, in 1891. He was graduated from the Texas Agricultural and Mechanical College in 1911 with the degree of Bachelor of Science in mechanical engineering. He later took graduate work at this institution and was instructor in mechanical engineering in 1912 and 1913. He received the degree of Mechanical Engineer in 1912 and of Chemical Engineer in 1913.

He was awarded a fellowship in engineering at the College of Engineers of the University of Wisconsin for 1913-14 and received the degree of Master of Science in 1914. After serving two years as instructor in steam and gas engineering at this institution and specializing in research pertaining to the science of heat transmission, with particular attention to heat transfer through insulation, he became general consulting engineer for the Johns-Manville Corporation.

Mr. McMillan was a member of the American Society of Mechanical Engineers, American Society of Heating and Ventilating Engineers, the American Society of Refrigerating Engineers and the Society of American Military Engineers, and belonged to the Engineers Club, Western Universities Club, and the Texas Agricultural and Mechanical College Club of New York.

Always a very active member of the American Society of Mechanical Engineers, he was a member of the Council at the time of his death. His research work on heat insulation was notable. In 1916 he received the Junior Award of the American Society of Mechanical Engineers for a paper entitled "The Heat Insulating Properties of Commercial Steam Pipe Covering." Other notable papers presented by him were "Heat Transfer Through Insulation in the Moderate and High Temperature Fields" and "Heat Insulation Practice in the Modern Steam Generating Plant."

He was frequently called upon to read papers before other engineering societies, and contributed many articles on various phases of insulation to the technical press. He prepared technical data for Kent's and Marks' Handbooks, the American Society of Heating and Ventilating Engineers' Guide, the Handbook of the National District Heating Association and similar publications.

Due to his standing in his profession he was prominently identified with the National Research Council. From 1924 to 1928 he served on the subcommittee on heat transfer and in 1928, when the Division of Engineering and Industrial Research authorized the organization of the committee on heat transmission he was elected a member of the executive committee and also appointed chairman of the subcommittees on thermal insulation.

His services for the Johns-Manville Corporation constituted a record of marked achievement in the insulation field. Always searching for improved methods, he had to his credit the development of many important insulating materials and improvements in their manufacture and application. The thermal insulation testing laboratory of the corporation at its Manville factory, regarded as one of the most completely equipped private laboratories in the United States for investigation work pertaining to all classes of insulating materials, was established under Mr. McMillan's direction. His research work in connection with this laboratory has resulted in the improvement and standardization of many important insulating products.

Mr. McMillan was an enthusiast in aviation and had great confidence in the future of the industry. He was a licensed pilot, capable of expert control of planes himself and frequently utilized this method of transportation in traveling over the wide range of territory covered by his professional activities.

Coming Meetings

The Illuminating Engineering Society will convene at Philadelphia September 24 to 27, in the Bellevue-Stratford Hotel. Besides the usual features the technical program will include a symposium on ultraviolet radiation, including Hygienic Effects of Ultraviolet Radiation in Daylight by H. P. Gage, Recent Developments of Window Materials and Fabrics for Transmitting Ultraviolet Radiation, by W. W. Coblentz, and Sunlight—Natural and Synthetic, by C. E. Greider and A. C. Downs.

The American Refractories Institute and the **Refractories Division, American Ceramic Society** will hold their joint Fall meeting in Columbus, O., on Tuesday, September 24 in the Deshler-Wallick Hotel.

The 18th Annual Safety Congress of the National Safety Council will be held at Stevens and Congress Hotels, Chicago, September 30 to October 4.

Inquiries Received

For further information address THE GLASS INDUSTRY

469. Where can we get mirrors which are both concave and convex so as to give a distorted reflection?

What the World Wants

Specific inquiries for American Goods Received in the Department of Commerce, Washington, D. C.

Brazil—40449. Imitation crystal glassware for household use.

Panama—40389. Babies nursing bottles.

Italy—40356, Miscellaneous of glass, terra cotta, etc., for jellies and jams.

Panama—40389. Household glassware.

Switzerland—40039, Novelties and specialties for 5- and 10-cent stores.

Austria—40182. Glassware and porcelain.

Peru—40201. Glassware and pottery.

READERS' WANTS AND OFFERS

A GRADUATE ENGINEER

WHO HAS HAD eleven years' experience in the glass business is open for engagement. Experienced in glass making, furnace construction and operation. Production work in the manufacturing of bottles by Lynch, Owens and O'Neill machines. Also extensive experience with press and blow machines. Address S. W. 8. c/o THE GLASS INDUSTRY, 50 Church St., New York.

FOURCAULT PROCESS

BELGIAN SPECIALIST in the Fourcault process with ten years of experience in construction manufacture and management of furnaces and machines desires a position where full responsibility can be assumed. Speaks several languages. Best of references in Europe and U. S. A. Address A. B. C., care of THE GLASS INDUSTRY, 50 Church Street, New York, N. Y.

For Sale: CULLET of all Descriptions
Free from Caps, Wires, etc.
GEORGE F. BAUMANN, Dealer,
1110 Carroll Street, Brooklyn, New York.
Carloads Ready for Immediate Shipment.

GLASS PLANT BARGAIN

For Sale or Lease
on
Startling low terms

Completely equipped glass plant for wide-mouth and pressed and blown ware, also adaptable for diversified line. Convenient to raw materials. Excellent shipping facilities. Low taxes. Delightful living conditions; plant and location offers every desirable feature for manufacturer who desires to expand or relocate his plant. Detailed information on request.

Massillon Industrial Commission
Massillon, Ohio

Current Prices of Glass-Making Materials

August 20, 1929

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.46	.46
Hydrochloric (HCl) 20° tanks, per 100 lb		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	..	.38
Alcohol, denatured	gal.	..	.52
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.21-.22
Ammonia water (NH_4OH) 26° drums	lb.	.03	.03¼
Antimony, metallic (Sb)	lb.	..	.09⅝
Antimony oxide (Sb_2O_3)	lb.	..	.12-.14
Antimony sulphide (Sb_2S_3)	lb.	..	.14
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.05
Barium carbonate ($BaCO_3$)			
Precipitated	ton	57.50-59.50	60.00-61.50
Natural, powdered, imported	ton	45.00	50.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	.04¾-.05½
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08¼	.08½
Barium selenite ($BaSeO_3$)	lb.	..	..
Barium sulphate, in bags	ton	..	..
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point	ton	15.00-16.00	18.00
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Bone ash	carlots, lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.02½-.02¾	.02¾-.03¾
Boric acid (H_3BO_3)	lb.	.05½-.05¾	.06-.07
Refined	lb.	.05½-.05¾	.06-.07
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.00-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.27	.29
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.28-.30
Black prepared	lb.	..	.30
Cryolite ($Na_3Al F_6$) Natural Greenland Kryolith)	lb.	.09	.10-.10½
Artificial or Chemical	lb		.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.15-1.20
Feldspar—			
100 mesh	ton	11.00-12.50-20.00	12.50-22.00
80 mesh	ton	11.00-11.75	14.50
40 mesh	ton	11.00	13.50
Fluorspar (CaF_2) domestic, ground, 95-98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Formaldehyde	lb.	..	.08¾-.09¾
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.03¼-.03½
Black (FeO)	lb.	.03½	..
Kaolin (f.o.b. mine)	ton	9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolith)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.09¼	.10¼
Litharge (PbO)	lb.	.09¼	.09¼
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	6.50-11.50	..
Burnt (CaO) ground, in bulk	ton	8.00	..
Burnt, ground, in paper sacks	ton	10.00-11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15-2.25	2.30-2.60
Limestone ($CaCO_3$)		2.00-2.50	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.07
Manganese 85% (MnO_2)	lb.	.04	.04½
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35-.35½
Plaster of Paris, bags	ton	..	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.09	.09¾
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06½	.07
Hydrated 80-85%	lb.	.05¾	.06¼
Potassium chromate (K_2CrO_4)	lb.	..	.23-.32
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.05⅞-.06
Potassium permanganate ($KMnO_4$)	lb.	.16	.16½
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.23
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	1.90-2.00
Silver nitrate ($AgNO_3$) (100 oz.) per oz.		..	.36½
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.22½	..
In barrels	Per 100 lb.	1.55-1.57½	1.80
In bags	Per 100 lb.	1.37½-1.40	1.62½
Spot orders	.025 per 100 lbs. higher		
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.90	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04½
95 per cent.	Per 100 lb.	2.08	2.30
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.50
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags.	Per 100 lb.	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.39	.37½
Tin oxide (SnO_2) in bbls.	lb.	..	.50
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.50-2.00
Zinc oxide (ZnO)	lb.	.08½	.12
American process, Bags	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to July 24, 1929

	June 1928 Quantity	June 1928 Value	June 1929 Quantity	June 1929 Value	Six Months Ending June, 1929 1928 Quantity	Six Months Ending June, 1929 1928 Value	Six Months Ending June, 1929 1929 Quantity	Six Months Ending June, 1929 1929 Value
Glass and glass products (total)	.....	821,974	.....	927,158	.....	4,771,910	.....	5,497,657
Plate and window glass—								
Window glass, common, box 50 sq. ft.	1,851	9,015	1,146	8,066	9,066	51,338	10,586	57,808
Plate glass, unsilvered, sq. ft.	240,743	51,074	212,898	73,848	1,115,143	339,607	1,159,226	405,761
Other window and plate glass lbs.	243,076	24,984	262,927	33,747	1,630,922	190,928	2,264,556	240,579
Glass containers (bottles, vials and jars)	.....	331,902	.....	352,186	.....	1,705,386	.....	1,738,486
Table glassware, plain	.....	108,763	.....	125,832	.....	647,920	.....	763,676
Table and other glassware, cut or engraved	.....	9,252	.....	8,769	.....	56,070	.....	61,628
Lamp chimneys and lantern globes lbs.	105,342	19,818	103,763	19,906	967,612	188,759	774,388	160,456
Globes and shades for lighting fixtures lbs.	140,318	51,139	160,526	57,133	809,935	303,653	1,051,823	385,683
Chemical glassware lbs.	13,280	12,733	23,068	19,616	100,936	88,925	118,901	107,878
Electrical glassware, except for lighting lbs.	285,891	28,352	481,747	45,096	2,474,750	198,792	3,467,092	264,575
Other glassware	.....	174,942	.....	182,359	.....	1,000,532	.....	1,311,127

IMPORTS

Corrected to July 24, 1929

Glass and glass products	.....	1,134,539	.....	1,363,097	.....	6,762,071	.....	6,705,741
Cylinder, crown and sheet—								
Unpolished, not bent, obscured, beveled, etc.—								
Weighing less than 80 pounds per case dut. lb.	2,078,214	54,583	6,248,868	173,543	17,648,170	506,186	23,550,559	619,058
Weighing 80 pounds or over per case dut. lb.	3,063,446	134,919	6,123,747	253,631	17,659,813	770,289	20,378,182	775,967
Polished and bent, obscured, beveled, colored, etc., unpolished and polished, and all silvered dut.	.....	47,680	.....	72,113	.....	257,032	.....	330,877
Plate glass—								
Polished, unsilvered dut. sq. ft.	1,087,710	251,418	628,259	124,399	7,826,721	1,718,475	5,309,499	1,141,312
Other dut. sq. ft.	253,883	61,796	140,313	26,760	728,227	178,999	733,540	137,312
Bottles, vials, jars, demijohns and carboys, molded or pressed dut.	.....	20,554	.....	12,365	.....	103,090	.....	124,032
Table and kitchen utensils dut.	.....	19,614	.....	34,537	.....	132,455	.....	130,670
Glassware, cut or decorated dut.	.....	221,170	.....	313,799	.....	1,195,795	.....	1,422,495
Blown glassware, n. e. s.—								
Bottles, ornaments, gauge glasses and other n. e. s. dut.	.....	94,627	.....	83,422	.....	464,931	.....	515,222
Bulbs for electric lamps dut. No. 1	1,236,863	11,512	673,791	6,053	6,463,852	66,086	8,659,816	73,411
Chimneys, globes, shades, prisms and other illuminating glassware dut.	.....	64,709	.....	57,906	.....	431,917	.....	450,788
Articles and utensils for chemical, scientific, and experimental purposes dut.	.....	50,591	.....	65,340	.....	266,713	.....	295,724
Other glassware dut.	.....	101,366	.....	139,229	.....	670,103	.....	688,873